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Synopsis of the Oryctini (Coleoptera: Scarabaeidae: Dynastinae) from the Brazilian Amazon

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Abstract. The Oryctini (Coleoptera: Scarabaeidae: Dynastinae) is a large tribe of worldwide distribution with approximately 26 genera and 230 species. Fourteen genera and 113 species are found in the Neotropical region. Knowledge of the tribe in the Neotropics is fragmentary, necessitating further studies that address taxonomy, biology, and geographical distribution patterns. This study surveyed the Oryctini of the Brazilian Amazon. The composition of the group in the study area consisted of 7 genera, 18 species and 2 subspecies found in 7 states, 91 municipal districts, and approximately 167 specific localities. States with larger number of species are Amazonas and Pará, with 17 and 13 species respectively. *Heterogomphus eteocles* Burmeister, *Heterogomphus aidoneus* (Perty), *Heterogomphus telamon* Burmeister, *Megaceras crassum* Prell, and *Megaceras laevipenne* Prell are reported for the first time from the study area. *Megaceras laevipenne* is reported for the first time from Brazil. The taxonomy, descriptions, distribution maps, and biological and ecological data are provided for all species. A character analysis is provided as well as an identification key for all oryctine species that occur in the Brazilian Amazon.

Introduction

The superfamily Scarabaeoidea, considered as a monophyletic group (Lawrence and Britton 1991), includes 12 families and approximately 29 subfamilies (Lawrence and Newton, 1995; Browne and Scholtz, 1999). This diverse scarab group has been divided in two ecological groups (Erichson 1848): Laparosticti (dung beetles), characterized by having most of the abdominal spiracles located on the pleural membrane between the tergites and sternites and the Pleurosticti (leaf-feeding beetles or leaf chafers) characterized by having most of the spiracles situated on the upper portion of the sternites. The two groups are commonly included in the Scarabaeidae, the biggest and most diverse family within Scarabaeoidea. Dynastinae is one of the best known subfamilies of Scarabaeidae. These conspicuous scarabs occur in all of the major biogeographic areas of the world, although most species are found in the tropics, specifically the New World tropics (Endrödi 1985; Ratcliffe 2003; Ratcliffe and Cave 2006).

The scarab tribe Oryctini occurs worldwide (except for Australia and the northern regions of Europe, Asia and North America) and comprises about 26 genera and about 230 species worldwide. Approximately 135 species occur in the Americas, 46 species in the Afrotropical region, and 31 species in the Oriental region (Endrödi 1985; Ratcliffe 2003). In Brazil, there are 7 genera and 44 species. All of these genera occur in the Brazilian Amazon with 14 species recorded from the region, constituting 10% of Neotropical dynastine diversity.

Adults of Oryctini are characterized by a large, robust, elongate body, with sides convex or nearly parallel; coloration mostly brown to black, rarely yellowish; mandibles exposed; antenna with 9-10 segments, club short or prolonged; protibia tri- or quadridentate with large teeth; apex of posterior tibia with teeth, lobes, or crenulations; prosternal process either long or short; pronotum usually with marginal bead; elytra smooth, with striae or rows of punctures; and propygidium mostly with a well developed stridulatory area.

As in most Dynastinae the sexual dimorphism in Oryctini is pronounced with the males possessing prominent tubercles, prominences, or horns on the head and/or pronotum. In males, the sides of the pronotum may have structures or rugose areas; in some species of *Heterogomphus* Burmeister there are tubercles or small prominences above the lateral margin; in most species of the genus *Megaceras* Hope there is a rugose area called the *areola apposita*. The Oryctini exhibit allometric growth of their horns; the form and size of the horns in males of the same species may vary considerably. Males with large horns are called "major males", and males with small horns are called "minor males". The body size and development of horns is determined by nutritional conditions of the larvae during periods of growth and development (see Ratcliffe 2003).

Oryctine larvae are distinguished by a cranium that is densely punctate, dark to reddish brown; maxillary stridulatory teeth truncate; antenna with 2-14 dorsal sensory spots on the last segment; and raster without palidia or a septula (Ritcher 1966).

Adults are nocturnally active and usually attracted to lights at night. During the day, they seek shelter and remain hidden. Some species feed on rotting fruit or decaying vegetation, while others species make tunnels in the stems of living plants, such as sugarcane and several species of palms (Ratcliffe 2003). Some larvae live in the soil feeding on decaying organic matter, while others live in accumulations of compost in rotting tree trunks or roots, in the large stems of palms, or in the nests of ants (Morón et al. 1997).

Knowledge of the Oryctini is fragmentary in the Neotropics. Few works deal with the diversity, taxonomy, and phylogenetic relationships of species. The first species list for Mexico, Central America and South America was made by Blackwelder (1944), which included the species of the tribe Pentodontini within Oryctini. Only two works may be considered as complete revisions for the group. The oryctine genera and species for Central and South America were reviewed by Endrödi (1976) in his fifth monograph on Neotropical Dynastinae, in which the tribe Oryctini was represented by 103 species and 11 genera. Endrödi (1985) monographed the Dynastinae of the world and provided an identification key for the species from the Americas.

New combinations, synonyms, and distribution records of some oryctine species were provided by Ratcliffe (1982) and Ratcliffe and Dechambre (1983). Ratcliffe (1976) reviewed the genus *Strategus* Kirby, described eight new species, established 12 new synonyms, and provided a key to males and females. Iannuzzi and Marinoni (1995) reviewed the genus *Coelosis* Hope, recognizing new characters to establish the relationship of species using phenetic systematics.

In Brazil, Riehs (2005, 2007) studied the community composition and phenology of some species of Oryctini in Paraná state. In the Brazilian Amazon, studies on the tribe pertain to Dynastinae faunistic surveys from several localities of the region. The fauna and the phenology of some species of Oryctini were studied in localities of Itacoatiara (Andreazze and Fonseca 1998), Novo Airão, Barcelos (Andreazze 2001) and São Gabriel da Cachoeira (Andreazze and Motta 2002), in Amazonas state.

Oryctine scarabs need a comprehensive taxonomic revision and phylogenetic analysis. Relationships among the genera of the tribe Oryctini have not been addressed. The tribe Pentodontini is considered the sister group of Oryctini, but the monophyly of the taxa is not well defined. Some authors like Arrow (1937), Blackwelder (1944), Saylor (1948) and Arnett (1968) included the pentodontines within the Oryctini, whereas Endrödi (1976) redefined the Oryctini and re-established the Pentodontini as a distinct tribe. Although the two tribes may be separated by the presence of a truncate apical rim on the apex of the

posterior tibia in the pentodontines and by a crenulate rim in the oryctines, this variable or transitional character used to separate taxa at the tribal level is still questionable.

Study Area

The Brazilian Amazon consists of the Amazon rainforest and its related ecosystems in Brazil. It encompasses approximately 4.2 million square kilometres. The Legal Amazonia is a politically defined area spanning nine Brazilian states: Acre, Amapá, Amazonas, Maranhão, Mato Grosso, Pará, Rondônia, Roraima and Tocantins, and eight different ecological regions. It covers 5.1 million square kilometers, or 61 percent of Brazil's territory. Significant portions of Maranhão, Mato Grosso and Tocantins and outside Amazonia (IBGE 2000).

The Brazilian Amazon is located in the low-lying Amazon Basin. The Amazon River system is the single largest source of fresh-water on Earth, carrying an astounding 16 percent of all the river water in the world over its 6,500 miles. The flow regime of the Amazon River is affected relatively little by humans and is subject to annual variability in tropical precipitation that is ultimately translated into large variations in downstream hydrography. The recycling of local evaporation and precipitation by the forest accounts for a sizable portion of the regional water budget. Rainfall levels in the area range from 1.5 to 4.0 m (Cerri et al. 2003).

The Amazon region is dominated by old, highly weathered, leached soils, a result of large areas of tectonically and geomorphologically stable land surfaces. The main soils developed under these conditions can be grouped under modal Kaolisols, which include the ferralitic soils or Oxisols and Ultisols (deMoraes et al. 1996).

Material and Methods

Specimens used in this study were examined from six primary institutions. Acronyms for loan institutions follow Arnett et al. (1993). The collections including curators and/or collection's managers who provided material, are:

CZPB/UFAM	Coleção Zoologica Prof. Paulo Bührnheim, Universidade Federal do Amazonas, Manaus, AM, Brazil. (Nair Otaviano Aguiar)
INPA	Instituto Nacional de Pesquisas da Amazônia, Manaus, AM, Brazil. (Augusto Loreiro Henriques)
MPEG	Museu Paraense Emílio Goeldi, Belém, PA, Brazil. (Orlando Tobias Silveira)
MZSP	Museu de Zoologia, Universidade de São Paulo, São Paulo, SP, Brazil. (Sônia Casari)
IBSP	Instituto Biológico, São Paulo, SP, Brazil. (Sergio Ide)
UNSM	University of Nebraska State Museum, Lincoln, NE, USA (Brett Ratcliffe and Mary Liz Jameson)

The identification of species that occur in the Brazilian Amazon was made with descriptions and keys proposed by Endrödi (1976, 1985), Morón et al. (1997), Ratcliffe (2003), and Ratcliffe and Cave (2006). For each genus and species, we provide the nomenclatural history and complete synonymies. Descriptions are given for the males and females of all species and contain the following morphological characters: length and width (from apex of clypeus to apex of elytra and across widest part of elytra); color; sculpturing of the frons; shape and sculpturing of the clypeus; shape and size of mandibles; shape and size of the head tubercles and horns; sculpturing of pronotum; form and size of the tubercles and horns in pronotum; sculpturing of elytra; shape, hairiness and sculpturing of pygidium; and the form of the parameres of the male genitalia.

For the study of male genitalia, it was necessary to examine the form of the parameres because, with some exceptions, they are diagnostic. The specimen was immersed in hot water mixed with liquid soap for several minutes in order to soften the body. The parameres were removed through the anal opening and cleared in boiling distilled water and a 5% KOH solution (Coca-Abia and Martín-Piera 1991).

Geographic distribution is given with the locality records presented in the following format: state, province or equivalent; and locale. A temporal distribution follows for each species. Distributional maps are provided for each species using the digital database of the Geographical Information System Laboratory (SIGLAB 2007) of INPA (Instituto Nacional de Pesquisas da Amazônia), supplied for the Electric Energy National Agency (ANEEL 2002) and Geography and Statistics Brazilian Institute (IBGE 2000).

A brief diagnosis, information on biology, life history notes, habitat preference (when known), and elevational range are included for each species.

A conventional artificial key for all species in presented for each genus. We use characters that are consistently expressed, low in intrinsic variability and observed with reasonable procedures. The keys and descriptions of each species are accompanied by illustrations made with the use of a camera lucida. Specimens were observed with a stereomicroscope.

The phylogenetic species concept (Wheeler and Platnick 2000) was applied in this work: "A species is the smallest aggregation of (sexual) populations or (asexual) lineages diagnosable by a unique combination of character states."

Results

Oryctini Mulsant 1842

Original spelling and citation: Oryctésaires Mulsant 1842: 372
Type genus: *Oryctes* Illiger 1798: 11 (Kugelann and Illiger 1798)

Synonym: Megacerini Burmeister, 1847
Original spelling and citation: Megaceridae Burmeister 1847: 212
Type genus: *Megaceras* Hope 1837: 82

Synonym: Strategini Burmeister, 1847
Original spelling and citation: Strategidae Burmeister 1847: 87
Type genus: *Strategus* Kirby 1828: 644 (Kirby and Spence 1828)

DIAGNOSIS. Head and/or pronotum with tubercles or horns (especially males), pronotum of most species with fovea (especially females). Antennal club small. Mandibles with lateral lobes or teeth. Apex of metatibia strongly crenulate or toothed. Prosternal process prominent, columnar.

Key to the genera of adult Oryctini of Brazilian Amazonia

1. Protibia tridentate **2**
— Protibia quadridentate **3**

2(1). Elytra smooth, black, shiny. Clypeus emarginate or truncate (bidentate in *M. philoctetes*). Mandibles bidentate ..... ***Megaceras* Hope**
— Elytra with 5 distinct rows of punctures on relatively smooth surface. Clypeus with apex sharply bidentate. Mandibles tridentate ..... ***Coelosis* Hope**

3(1). Elytra with deeply furrowed rows of punctures. Mandibles broad, with 2 lobes, strongly projecting from beneath clypeus. Clypeus with a conical tubercle on dorsal surface. Pronotal fovea of males broadly triangular, extending almost to posterior margin of pronotum ..... ***Gibboryctes* Endrödi**
— Elytra smooth, rugose, or with punctures, never with deeply furrowed rows of punctures. Mandibles variably toothed, never with 2 large lobes. Head with 1-2 conical tubercles in frontoclypeal region, never with 1 on top of clypeus. Males with pronotal fovea variable in form **4**

4(3). Body form elongate, subparallel. Protibia with teeth projecting almost at right angles. Apex of metatibia with 2 strong teeth. Males with anterior half of pronotum nearly smooth and with single, median horn or tubercle. Females without fovea on pronotum .. ***Podischnus*** **Burmeister**

— Body form broader, sides rounded (not subparallel). Protibia with teeth projecting obliquely. Apex of metatibia crenulate or with 1, 3, or 4 teeth. Males with anterior half of pronotum densely punctate or rugose or, if nearly smooth, then with lateral horns or tubercles. Females with or without fovea on pronotum **5**

5(4). Both males and females with head horn. Prosternal process short. Pronotum with anterior margin distinctly emarginate at center ..... ***Enema*** **Hope**

— Males with or without head horn; females never with head horn, instead tuberculate at most. Prosternal process long or subconical. Anterior margin of pronotum lacking emargination at center **6**

6(5). Frons in males and females unarmed or with 2 tubercles, never with horn on the head. Mandibles tridentate. Pronotum in males with subapical horn and usually with lateral horn or elevated, triangular ridge on each side; females with fovea in anterior third of pronotum .... ***Strategus*** **Kirby**

— Males usually with distinct head horn; females with single tubercle. Mandibles without teeth, or with 1-2 rounded teeth. Pronotum in males with horn or prominence arising from posterior half and with or without lateral horns; females usually lacking pronotal fovea .... ***Heterogomphus*** **Burmeister**

Coelosis **Hope 1837**

Coelosis Hope 1837: 88
Millotsis Bourgin 1944: 143 (synonym)

Type species: *Geotrupes sylvanus* Fabricius 1775

Species of *Coelosis* may be distinguished by the tridentate protibiae, head of male with a horn, elytra with distinct rows of punctures, clypeus usually narrow and bidentate at its apex, and mandibles tridentate. Adults are nocturnal and attracted to lights. The genus contains seven species and is widely distrubuted in the New World (Endrödi 1976, 1985). Six of them are reported in Brazil, and two species occur in the Brazilian Amazon.

Key to the species of adult *Coelosis* of Brazilian Amazonia

1. Pronotum with 2 subparallel horns, each with a rounded apex. Prosternal process long, triangular. Female pronotal surface with dense punctures (Fig. 4) ..... ***C. bicornis*** **(Leske)**

— Pronotum with larger, broad, bifurcate, dorsally flattened horn. Prosternal process short, rounded. Female with disc of pronotum lacking punctures. (Fig. 10) ..... ***C. biloba*** **(Linnaeus)**

Coelosis bicornis **(Leske 1779)**
(Fig. 1-7)

Scarabaeus bicornis Leske 1779: 418
Geotrupes bicornis Fabricius 1801: 9 (redescription)
Coelosis bicornis recifensis Bourgin 1944: 137 (synonym, described as subspecies)
Scarabaeus codrus Olivier 1789: 179 (synonym)
Coelosis hippocrates Burmeister 1847: 216 (synonym)

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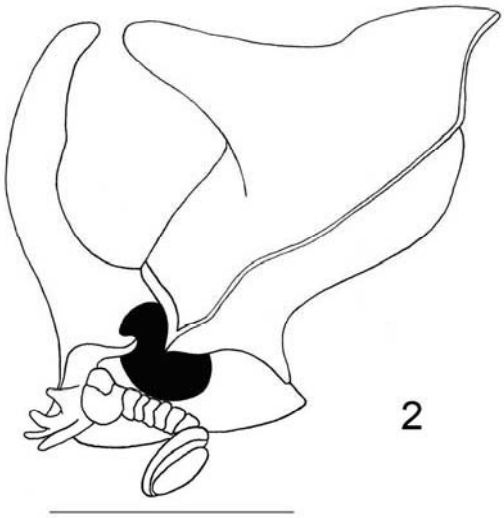

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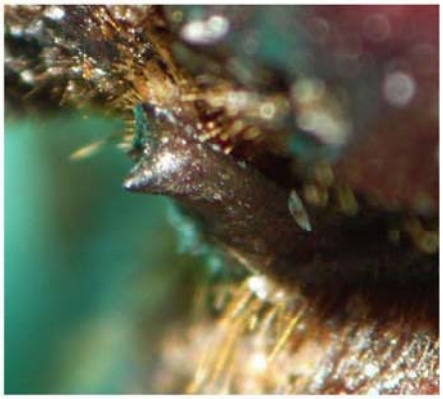

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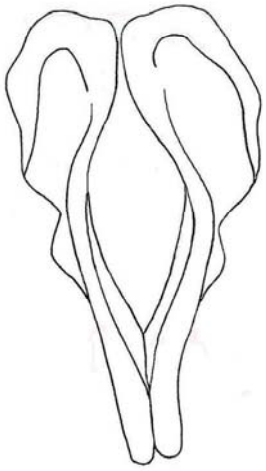

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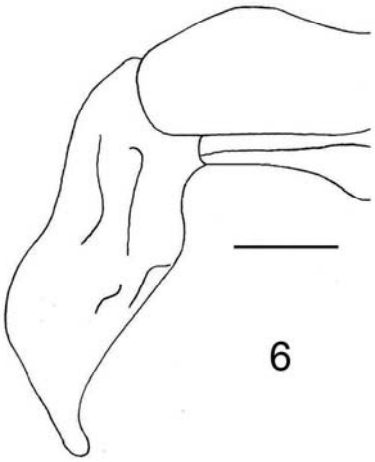

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Figure 1-6. *Coelosis bicornis.* **1)** Habitus. **2)** Male head and pronotum (scale line: 5 mm). **3)** Prosternal process. **4)** Female pronotum dorsal view. **5)** Parameres frontal view. **6)** Parameres lateral view (scale line: 1 mm).

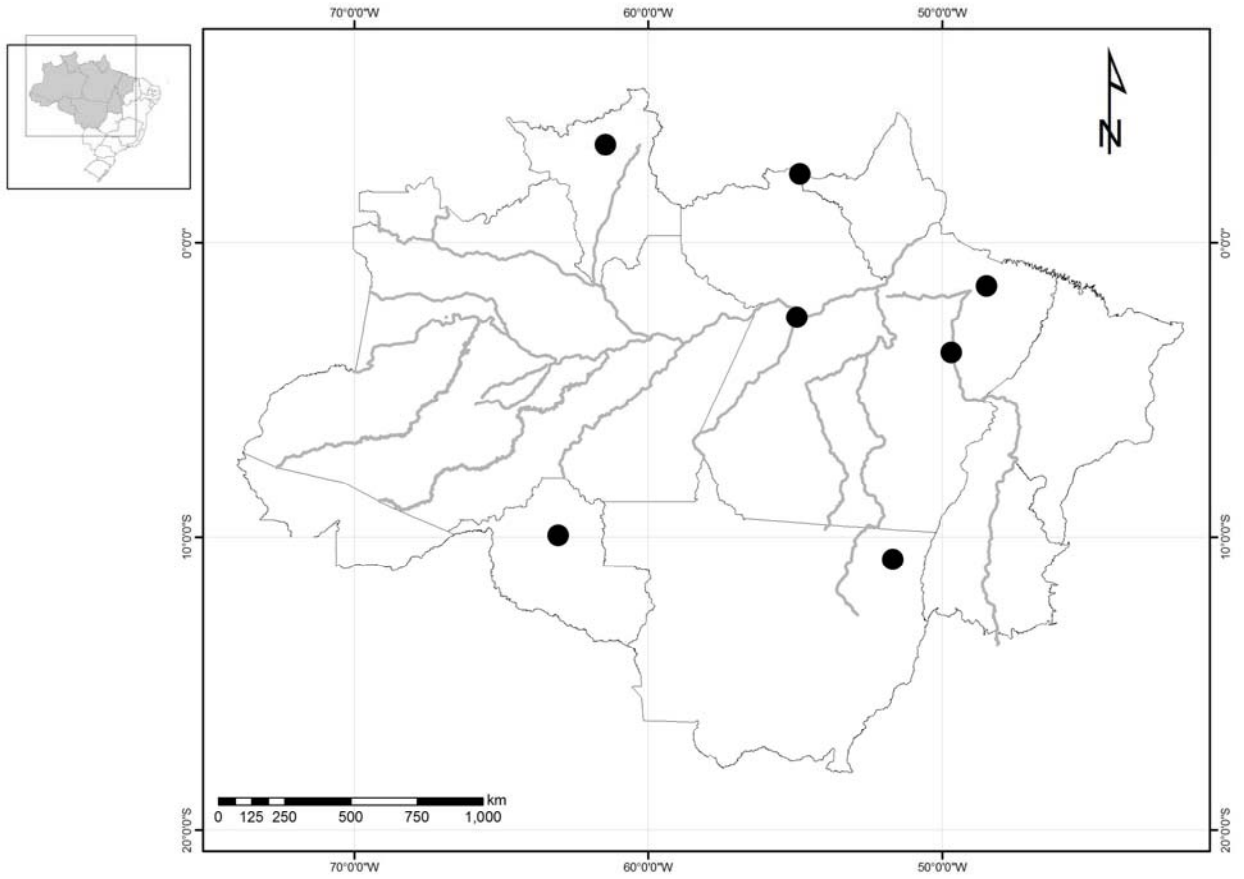

Figure 7. Distribution of *Coelosis bicornis* in Brazilian Amazonia.

DESCRIPTION. Length: 26.1-30.5 mm (males); 23.6-25.0 mm (females). Width: 13.7-15.1 mm (males); 13.1-15.0 mm (females). Color: Light to dark reddish brown.

Males. *Head*: Frons with recurved horn, apex acuminate, posterior margin with small, tooth-like swelling near apex. Male minors with horn slightly recurved. Eye canthus rounded at apex, anterior margin crenulate with row of setae. Clypeus subtriangular, surface strongly rugose, apex with 2 teeth. Mandibles with 3 strong, sharp teeth. Antenna with 10 segments, club subequal in length to segments 2-7. *Pronotum*: Surface in central third smooth, with deep, small punctures, sides strongly rugose. Male majors (Fig. 2) with 2 subparallel horns, curving forward. Fovea prominent, surface with small punctures. Male minors with protuberance only. *Elytra*: Surface between suture and humerus with 5-8 punctate striae; punctures deep, ocellate. Apex with 2 small protuberance. *Pygidium*: Surface strongly setose, punctate. In lateral view, strongly convex. *Legs*: Protibia tridentate. Apex of metatibia weakly crenulate, lacking teeth. Metatarsus with apex of first tarsomere triangularly produced, spur-like. *Venter*: Prosternal process long, triangular, with prominence on posterior surface (Fig. 3). *Parameres*: Basal region long, central region weakly concave in lateral view, apical region elongated and thin, apex narrow, recurved (Fig. 5-6).

Females. As males except in the following respects: *Head*: Frons with surface strongly rugose, with small tubercles. *Pronotum*: Surface lacking horns or tubercles, completely punctate (Fig. 4). *Pygidium*: Surface slightly punctate, densely and finely setose.

DIAGNOSIS. *Coelosis bicornis* can be distinguished by the two subparallel horns, clypeus with two teeth, tridentate mandibles, and a prosternal process with a strong prominence on the posterior surface.

DISTRIBUTION. *Coelosis bicornis* is widely distributed in South America, occurring from Colombia to the south of Argentina.

LOCALITY RECORDS. (Fig. 7) 19 specimens examined (13 males, 6 females). Specimens were seen from the following collections: INPA, CZPB, MPEG, UNSM.

MATO GROSSO (3): Barra do Tapirapé. PARÁ (10): Alter do Chão, Belém (Utinga), Tucuruí (Rio Tocantins, Ilha Tocantins); Parque Indígena Tumucumaque (Rio Parú de Leste), alto Tapajós (Rio Cururú). RONDÔNIA (5): Ariquemes. RORAIMA (1): Amajari (Ilha de Maraca, Rio Uraricoera).

TEMPORAL DISTRIBUTION. January (2), February (1), April (1), June (1), July (3), August (2), September (3), November (6).

NOMENCLATURAL REMARKS. *Coelosis bicornis* was described by Leske in 1779. Burmeister (1847) recognized *Coelosis hippocrates*, described by Blanchard in 1846, as a synonym of *C. bicornis*. In subsequent works, Bourgin (1944) and Endrödi (1976) considered *C. hippocrates* and *C. biloba* as different species. In a phenetic analysis, Iannuzzi and Marinoni (1995) indicated that the number of different characters between *C. hippocrates* and *C. bilo*ba was small. It seems necessary for more phylogenetic research to determine the validity of *C. hippocrates* Blanchard as a species.

BIOLOGY. Nothing is known of the life history of *C. bicornis* and of other species of the genus; most available information refers to *C. biloba.* Larvae presumably feed on organic matter in rotten trunks (Iannuzzi and Marinoni 1995). Adults can be collected using light traps. *Coelosis bicornis* occurs from sea level to about 200 meters in elevation, and it is associated with ombrophilous forests, areas of degraded vegetation, and flooded areas.

***Coelosis biloba* (Linnaeus 1767)**
(Fig. 8-13)

Scarabaeus biloba Linnaeus 1767: 544
Geotrupes bilobus Fabricius 1801: 7 (redescription)
Coelosis biloba Hope 1837: 82 (redescription)
Coelosis biloba lepesmei Bourgin 1944: 129 (unavailable name, described as aberration of *C. biloba biloba*)
Coelosis biloba incana Bourgin 1944: 129 (unavailable name, described as aberration of *C. biloba biloba*)
Coelosis biloba cacica Bourgin 1944: 131 (unavailable name, described as aberration of *C. biloba biloba*)
Coelosis biloba tibialis Bourgin 1944: 132 (synonym, described as subspecies)
Coelosis biloba tibialis pauliani Bourgin 1944: 134 (unavailable name, described as variation of *C. biloba tibialis*)

DESCRIPTION. Length: 29.5-37.8 mm (males); 25.6-35.5 mm (females). Width: 15.41-19.8 mm (males); 13.41-18.7 mm (females). Color: Shiny reddish brown.

Males. *Head*: Horn short to long, recurved; apex acuminate, posterior margin with small, tooth-like swelling near apex. Eye canthus rounded at apex, anterior margin crenulate with row of setae. Clypeus elongate, subtriangular, surface strongly rugose, apex with 2 teeth. Mandibles with 3 strong, sharp teeth. Antenna with 10 segments, club subequal in length to segments 2-7. *Pronotum*: Surface smooth in anterior third, with small punctures. Sides strongly rugose, central region smooth. Male majors (Fig. 9) with large, broad, bifurcate, dorsally flattened (almost laminar) horn on posterior half of pronotum. Male minors with horn variably reduced. Anterior angles elongated. Fovea prominent, surface smooth. *Elytra*: Surface with 5 punctate striae, punctures deep, oblong, ocellate. Sides similar. *Pygidium*: Surface convex at base in lateral view, without setae, densely punctate and slightly wrinkled. Apex with small setae. *Legs*: Protibia elongate, slender, lateral edge with 3 subequally spaced teeth. Apex of posterior tibia weakly crenulate, without teeth. Posterior tarsus with apex of first tarsomere triangularly produced. *Venter*: Prosternal process short, rounded, anterior half without setae, with a pronounced furrow. *Parameres*: Broad, apices obtusely acuminated, upper third convex with lateral striae, central third concave, lower third broad (Fig. 11-12).

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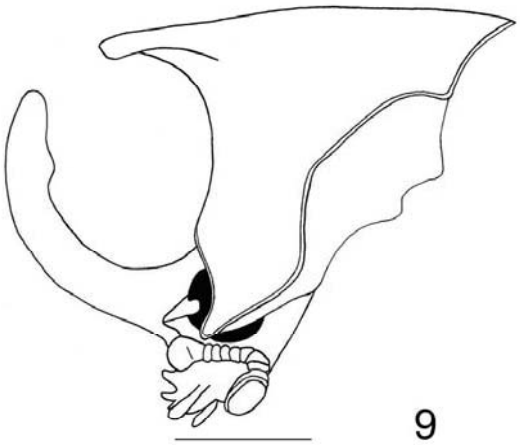

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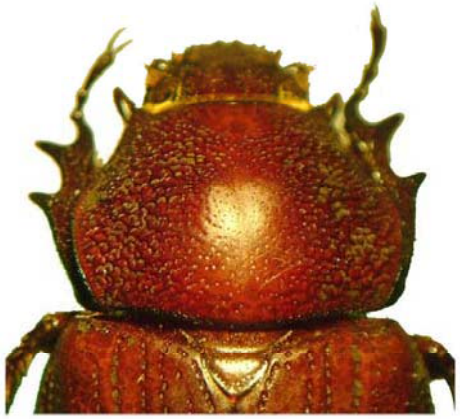

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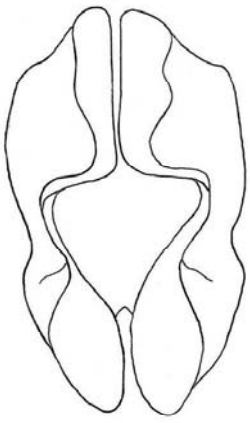

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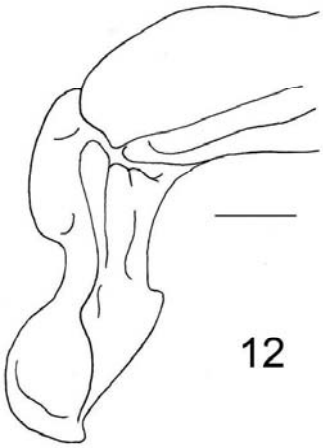

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Figure 8-12. *Coelosis biloba*. **8)** Habitus. **9)** Male head and pronotum (scale line: 5 mm). **10)** Female pronotum dorsal view. **11)** Parameres frontal view. **12)** Parameres lateral view (scale line: 1 mm).

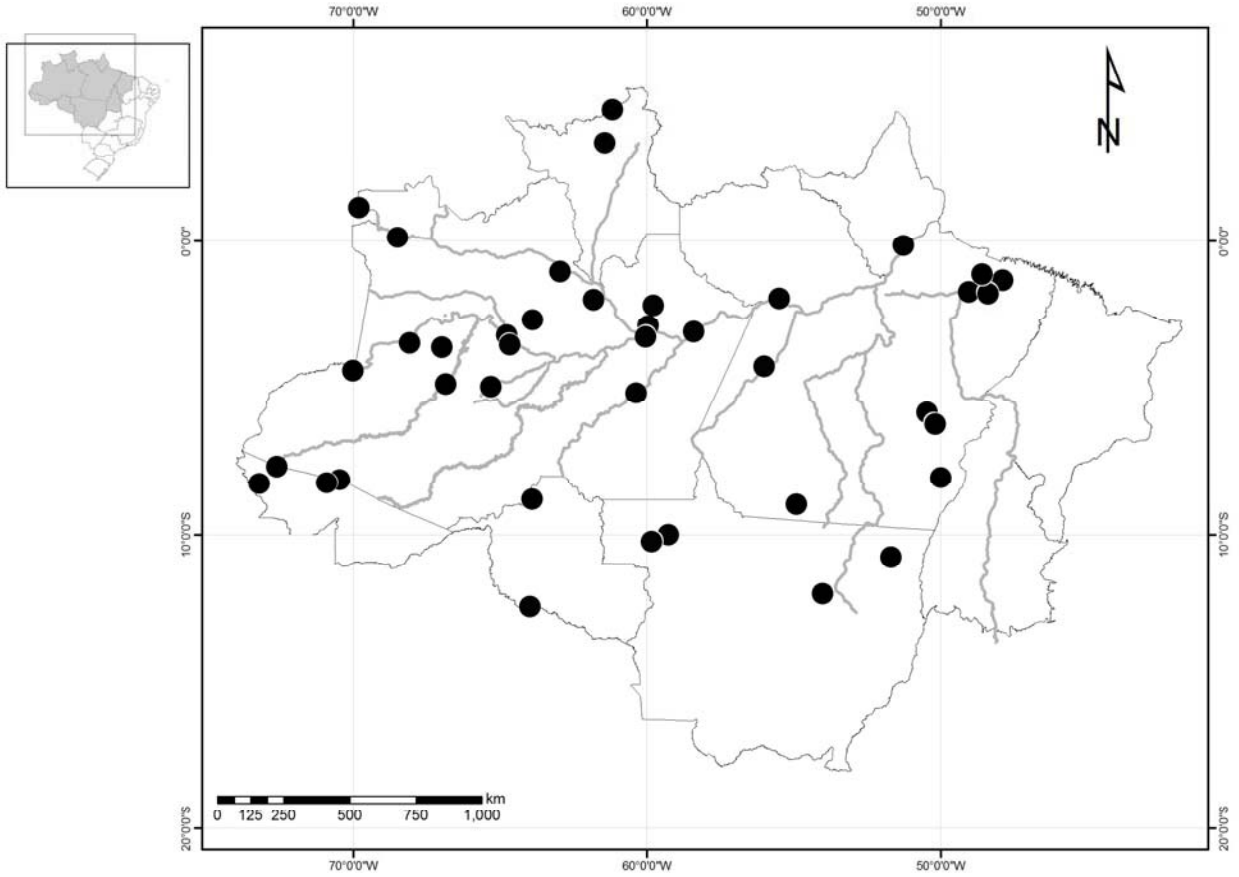

Figure 13. Distribution of *Coelosis biloba* in Brazilian Amazonia.

Females. As males except in the following respects: *Head*: Frons with surface totally rugose. *Pronotum*: Surface without horns or tubercles, sides with deep punctures, discal area smooth (Fig. 10). *Pygidium*: Surface with dense, small punctures.

DIAGNOSIS. *Coelosis biloba* is easily recognized by its clypeus that has two strong teeth, the tridentate mandibles, elytra with rows of punctures, and a broad, horizontal, bifurcate pronotal horn.

DISTRIBUTION. Of the seven 7 species in the genus, *Coelosis biloba* has the largest distribution, occurring from central Mexico to southern Argentina.

LOCALITY RECORDS. (Fig. 13) 144 specimens examined (89 males, 55 females). Specimens were seen from the following collections: INPA, CZPB, MZSP, MPEG, UNSM.

ACRE (11): Cruzeiro do Sul, Feijó, Purús, Rio Branco, Tarauacá. AMAPÁ (2): Mazação. AMAZONAS (92): Barcelos, Benjamin Constant (Rio Javarí), Carauari (Porto Gavião), Coari (Rio Urucu), Itacoatiara (Fazenda Aruanã, Am 10 km 215), Itamarati (Monte Calavário), Juruá (Mineruazinho), Manaus (Am 10 km 26, Am 60 km 23, BR 164 km 130, BR 174 km 60, INPA, Reserva Ducke), Maraã (Rio Japurá Maguari), Novo Airão (Refúgio Arambóia), Novo Aripuaná, Presidente Figueredo (Rio Urubu), Parque Nacional do Jaú, São Gabriel da Cachoeira (Querari), São Paulo de Olivença (Rio Solimões), Taracuá (Rio Uaupés), Tefé. MATO GROSSO (5): Aripuaná, Barra do Tapirapé, Reserva Humboldt, Xingú. PARÁ (25): Abaetutuba, Belém, Benevides, Cachimbo, Itaituba (Rio Tapajós), Óbidos (Canta Galo), Redenção (Ribeirão de Fogo), Parauapebas (Serra Norte: Manganês, Pojuca), Tapana. RONDÔNIA (6): Príncipe da Beira, Porto Velho (Rio Madeira). RORAIMA (3): Ilha de Maracá, Pacaraima.

TEMPORAL DISTRIBUTION. January (14), February (7), March (15), April (12), May (11), June (11), July (14), August (9), September (3), October (8), November (29), December (11).

BIOLOGY. Adults are nocturnal and attracted to lights, especially mercury vapor lights and ultraviolet lights, during the first months of the year, when the populations of beetles are high. Females of *C. biloba* lay eggs in leaf mulch of the preparation chambers of leafcutter ants, *Atta sexdens* (L.). The eggs are transported by the ants to the fungus gardens, where the scarab larvae feed on the organic matter that grows there (Eidmann 1937). *Coelosis biloba* has also been found in nest of *Atta cephalotes* (L.), *Atta mexicana* (Smith) (Bruch 1917; Navarrete-Heredia 2001) and *Atta columbica* Guerin (Neita et al. 2006). Pardo-Locarno et al. (2006) found larvae, pupae, and pre-pupae in the nest of *Atta* sp. in Colombia. The larvae of *C. biloba* may be parasitized by wasps of the genera *Campsomeris* Guérin and *Scolia* Fabricius (Hymenoptera: Scoliidae), which visit the nests of *A. sexdens* (Pardo-Locarno et al. 2006). They also observed cannibalism by adults feeding on third instar larvae. Adults can occasionally be collected with Malaise traps or with flight intercept traps.

In the Brazilian Amazon, this species is associated with degraded ecosystems dominated by plants of genus *Vismia* Vandelli, agriculture areas, semi-humid ombrophilous forests, savannahs, and flooded areas. It is found from the sea level to 400m.

Enema Hope 1837

Enema Hope 1837: 83
Hoplites Dejean 1836: 167 (*nomen oblitum*)

Type species: *Geotrupes pan* Fabricius 1775.

Enema is characterized by quadridentate protibiae, presence of a frontal horn in both sexes, broad elytra, bidentate mandibles, and the near absence of a prosternal process. Adults are nocturnal and attracted to lights, while the larvae probably feed on humus in the soil (Ratcliffe 2003). The genus consists of two species, *E. pan* (Fabricius) and *E. endymion* Chevrolat (Endrödi 1985). Both occur in Brazil and the Brazilian Amazon.

Key to the species of adult *Enema* of Brazilian Amazonia

1. Elytra bright reddish brown, head and pronotum usually darker. Frontal horn short, apex narrow. Pronotum with low, rounded tumescence ..... ***E. endymion* Chevrolat**
— Elytra, head and pronotum black. Frontal horn long, apex narrow. Pronotum with broad, anteriorly directed, bifurcate horn or simply bituberculate ..... ***E. pan* (Fabricius)**

Enema endymion Chevrolat 1843
(Fig. 14)

Enema endymion Chevrolat 1843: 29
Enema lupercus Burmeister 1847: 236 (synonym)
Enema paniscus Burmeister 1847: 236 (synonym)
Enema gibbicollis Sternberg 1908: 24 (synonym)

DESCRIPTION. Length: 32.4. Width: 18.5 mm (Range species. Length: 30.0-36.3 mm; width: 17.0-20.0 mm (Ratcliffe 2003)). Color: Light to dark reddish brown.

Males. *Head*: Frons with short to moderately long horn; horn narrowly triangular, acuminate, recurved. Margin of eye canthus weakly crenulate, surface punctate, apex rounded. Clypeus with surface rugopunctate, apex broad, emarginate. Antenna with 10 segments, club subequal in length to segments 2-7. Mandibles broad, apex strongly bidentate. *Pronotum*: Surface rugose along lateral margins and surrounding discal depression, with small punctures. Disc in anterior half with strong, longitudinal depression. Anterior margin with strong emargination at center. *Elytra*: Surface with strongly impressed

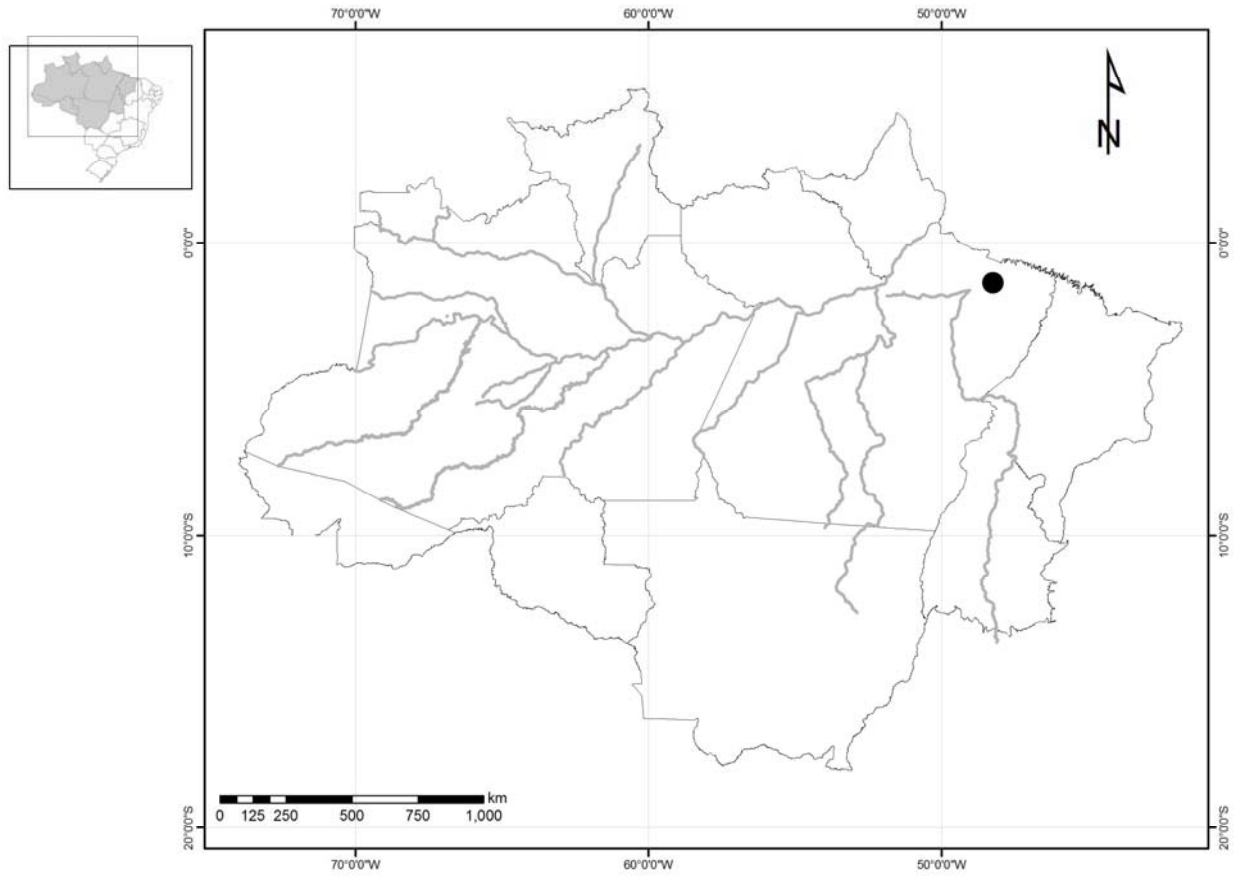

Figure 14. Distribution of *Enema endymion* in Brazilian Amazonia.

sutural stria, with small dense punctures and larger sparse punctures, sides strongly rugose and explanate. *Pygidium*: Base with transverse row of large, setigerous punctures. Apical margins rugose. In lateral view, surface convex. *Legs*: Protibia quadridentate, occasionally with all teeth equidistant. Apex of posterior tibia weakly crenulate and with small tooth. Basal segment of posterior tarsus triangularly elongated at apex. *Venter*: Prosternal process short, laminar, triangular. *Parameres*: Similar to those of *E. pan*.

Females. As males except in the following respects: *Head*: Frons with horn usually shorter. *Pygidium*: Surface nearly flat, weakly convex (Ratcliffe 2003; Ratcliffe and Cave 2006).

DIAGNOSIS. The reddish brown color and the short acuminate head horn in both sexes will distinguish this species from *E. pan*.

DISTRIBUTION. *Enema endymion* is found from southern Mexico to Brazil and Bolivia, including the Amazon region. It is a species with few records in Brazil, especially in the Amazon region, and is very rare in research collections.

LOCALITY RECORDS. (Fig. 14) 1 specimen examined (1 male). A specimen was seen from the following collection: MPEG.

PARÁ (1). Benevides.

TEMPORAL DISTRIBUTION. December (1).

BIOLOGY. The larval stages were described by Ratcliffe (2003). Larvae probably feed on humus, roots and organic debris in the soil (Ratcliffe 2003; Morón et al. 1997). Adults are nocturnal and are attracted to lights. It has been reported that the larvae are preyed upon by birds and mammals (Ratcliffe 2003).

***Enema pan* (Fabricius 1775)**
(Fig. 15-20)

Scarabaeus pan Fabricius 1775: 5
Scarabaeus chorinaeum Fabricius 1775: 5 (synonym)
Scarabaeus quadrispinosus Fabricius 1781: 11 (synonym)
Scarabaeus enema Fabricius 1787: 4 (synonym)
Scarabaeus aeneas Kirby 1818: 399 (synonym)
Scarabaeus titornus Perty 1830: 45 (synonym)
Enema lupercus Chevrolat 1843: 28 (synonym)
Enema infundibulum Burmeister 1847: 234 (synonym)

DESCRIPTION. Length: 45.0-58.5 mm (males); 43.4-53.6 mm (females). Width: 23.5-31.6 mm (males); 24.44-31.6 mm (females). Color: Black, occasionally dark reddish brown.

Males. *Head*: Frons with long, recurved horn, flattened on sides, largest specimens with small tooth on posterior edge. Eye canthus with apex weakly acuminate, anterior margin weakly crenulate, surface punctate. Surface of clypeus densely punctate, sides narrow and emarginate, apex broad and emarginate. Antenna with 10 segments, club subequal in length to segments 2-7. Mandibles broad, apex strongly bidentate. *Pronotum*: Male majors with surface rugose except for pronotal depression and knob, depression smooth with dense micropunctures; horn on posterior half of pronotum with anteriorly projecting, bifurcate process. Male minors similar except discal depression densely punctate, punctures small; posterior half densely punctate with a bifurcate tubercle. Sides of horn punctate, with a non-rugose region. *Elytra*: Surface with strongly impressed, crenulate, sutural stria. Discal area smooth, with dense micropunctures. Sides with large, dense, ocellate punctures in anterior half. *Pygidium*: Base with transverse band of large, setigerous punctures; setae long, reddish brown. Apical margins rugose. Surface convex in lateral view. *Legs*: Protibia quadridentate, occasionally with all teeth equidistant. Apex of posterior tibia weakly crenulate and with large tooth. Basal segment of posterior tarsus triangularly elongated at apex. *Venter*: Prosternal process short, triangular, apical half setigerous. *Parameres*: Simple, elongate, oval. (Fig. 18-19).

Females: Similar to male minors, head horn reduced.

DIAGNOSIS. This species can be recognized by the well developed frontal and pronotal horns in the males, and by the more elongated prosternal process. In Brazilian Amazonia, there are two morphotypes that show different horn morphology. The most common morphotype and has the pronotal horn bifurcate or bilobed and the frontal horn acuminate and recurved (Fig. 16); other specimens have the pronotal horn long and acuminate, and the frontal horn is weakly bilobed in the apex (Fig. 17).

DISTRIBUTION. *Enema pan* is widely distributed in South America, from Colombia to northern Paraguay (Endrödi 1985). There are some records for Mexico and Central America (Bates 1888); Ratcliffe (2003) and Ratcliffe and Cave (2006) found new records for Costa Rica, Panama, and Honduras.

LOCALITY RECORDS. (Fig. 20) 395 specimens examined (244 males, 151 females). Specimens were seen from the following collections: INPA, CZPB, MZSP, IBSP, MPEG, UNSM.

ACRE (8): Purús (Selva Alto), Rio Branco. AMAZONAS (339): Barcelos (Reserva Urini, Rio Urini Lago Três Bocas), Benjamin Constant (Rio Javari), Canutama (Nova Vista, igarape Gyssua), Carauarí, Coari (Rio Urucu), Eirunepe (Rio Juruá), Humaita, Itacoatiara (Fazenda Saracá), Manaus (Am 10 km 37, INPA, UFAM), Manicoré, Maraã, Maués, Novo Airão (Ramal do Olimpo), Parintins, Parque Nacional do Jau, Presidente Figueredo (UHE Balbina), São Gabriel da Cachoeira, São Paulo de Olivença, Silves, Tefé, Uariní. MATO GROSSO (12): Barra do Tapirapé, Reserva Humboldt, Xavantina. PARÁ (14): Altamira

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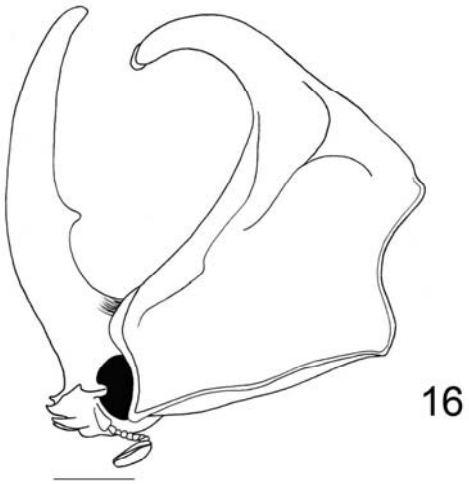

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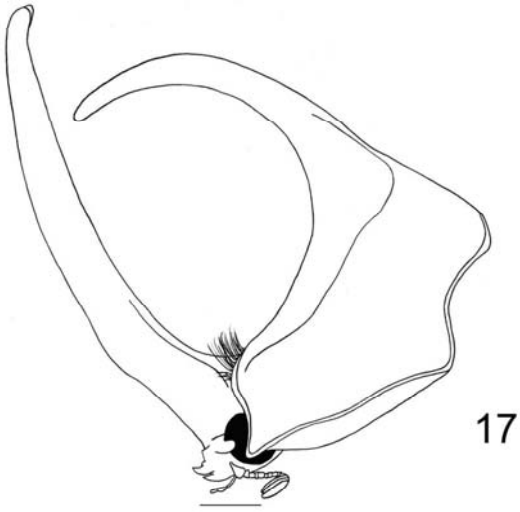

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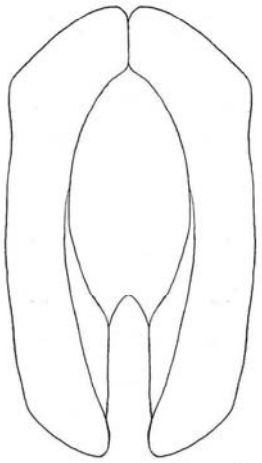

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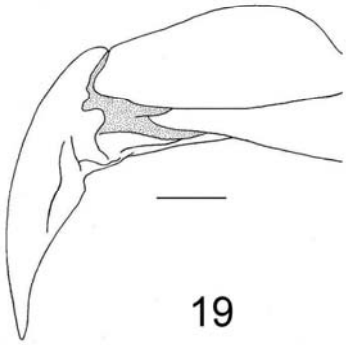

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Figure 15-19. *Enema pan*. **15)** Habitus. **16)** Male head and pronotum of the common morphotype (scale line: 5 mm). **17)** Male head and pronotum of the less-common morphotype (scale line: 5 mm). **18)** Parameres frontal view. **19)** Parameres lateral view (scale line: 1 mm).

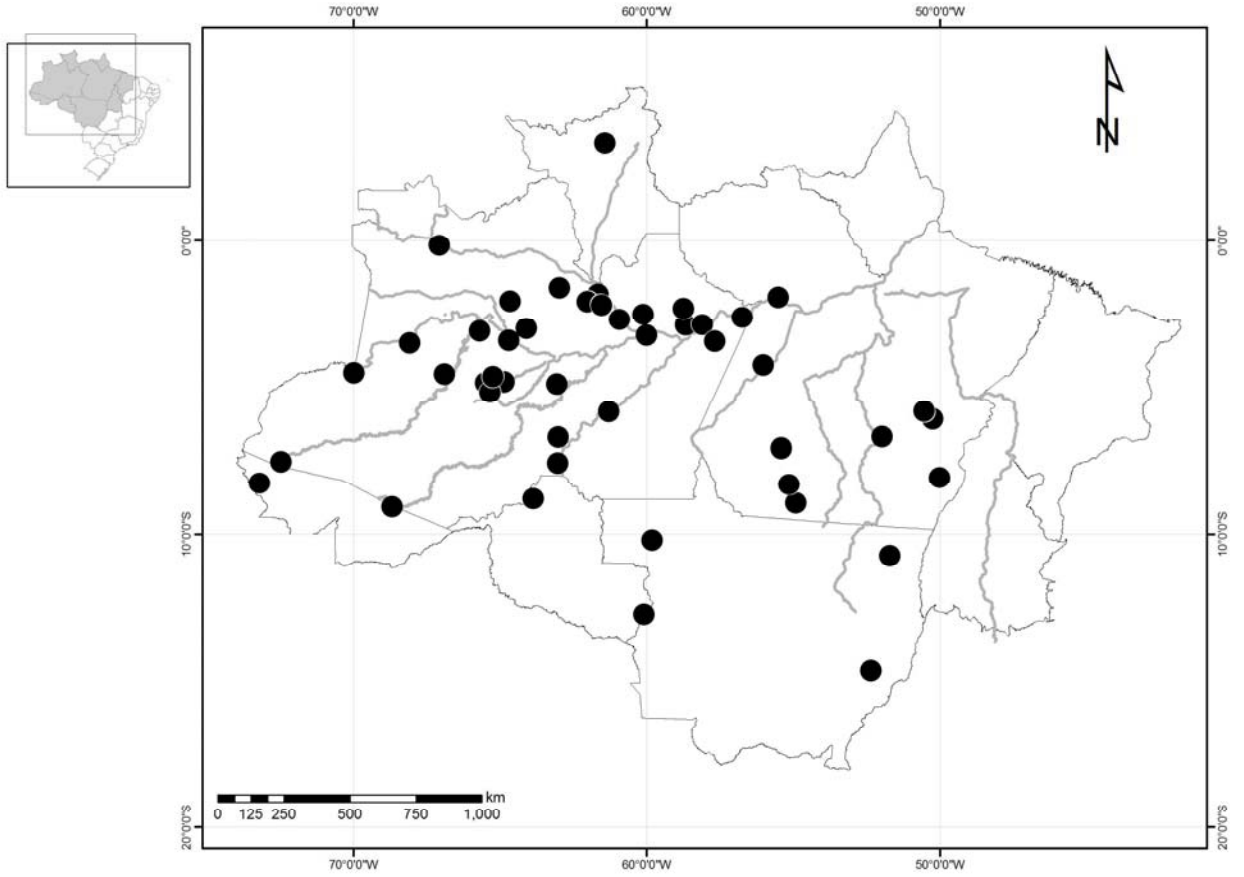


Figure 20. Distribution of *Enema pan* in Brazilian Amazonia.

(Castelo dos Sonhos), Cachimbo, Gorotire (Rio Fresco), Itaituba (Santaremsinho, Rio Tapajós), Novo Progresso, Óbidos, Redenção, Serra Norte (Serraria, Pojuca, Caldeirão). RONDÔNIA (21): Porto Velho, Vilhena. RORAIMA (1): Amajari (Ilha de Maracá, Rio Uraricoeira).

TEMPORAL DISTRIBUTION. January (2), February (4), March (2), April (1), June (5), July (3), August (18), September (41), October (156), November (148), December (7).

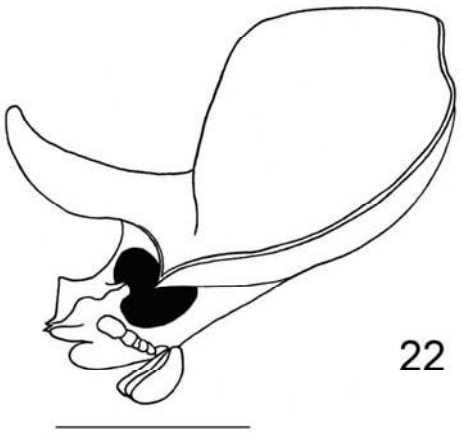
NOMENCLATURAL REMARKS. Endrödi (1976, 1985) and other authors recognized four morphotypes based in differences in the male pronotal and head horns. These morphotypes are considered synonyms of *E. pan* and represent substantial variation within a single species (Ratcliffe 2003).

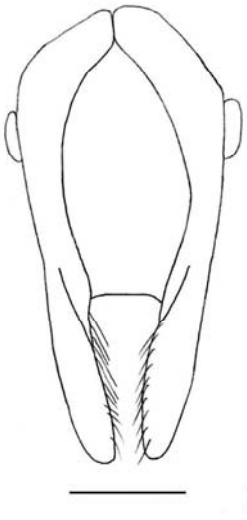
BIOLOGY. The life history of *E. pan* is mostly unknown. Adults are active at night and can be attracted to lights. During June to July and October to November, numerous adults were collected in Parque Nacional do Jaú in primary forest (Andreazze 2001) and at Coari on the Urucú River (N. O. Aguiar 2008, personal communication). In the Brazilian Amazon, they have been collected from elevations ranging from sea level to 400 m in semi-humid ombrophilous forests, savannahs, and areas of seasonal whitewater inundation forest (várzea).

Gibboryctes Endrödi 1974

Gibboryctes Endrödi 1974:13.

Type species: *Gibboryctes szelenyii* Endrödi 1974.





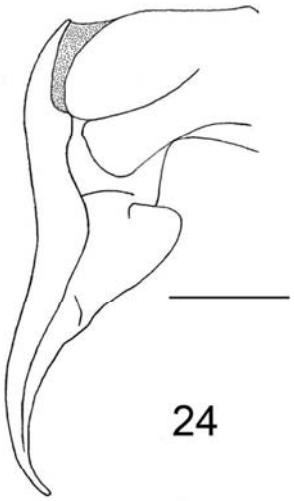


Figure 21-24. *Gibboryctes waldenfelsi.* **21)** Habitus. **22)** Male head and pronotum (scale line: 5 mm). **23)** Parameres frontal view. **24)** Parameres lateral view (scale line: 1 mm).

Gibboryctes is characterized by quadrientate protibiae, head short and widely triangular with an acuminate clypeus in the males, and a broadly rounded clypeus in the females, mandibles projecting from beneath the clypeus, and a pronotum with a deep, wide, almost triangular fovea. The genus contains four species in the New World (Dechambre 2006), with one, *G. waldenfelsi* (Endrödi, 1974) known from the Brazilian Amazon (Ratcliffe and Dechambre 1983).

***Gibboryctes waldenfelsi* (Endrödi 1977)**
(Fig. 21-25)

Strategus waldenfelsi Endrödi 1977: 335
Gibboryctes porioni Dechambre 1981: 124 (synonym)

DESCRIPTION. Length: 22.6 mm, given as 26.0-30.0 in Endrödi (1985). Width: 14.6 mm. Color: Dark reddish brown.

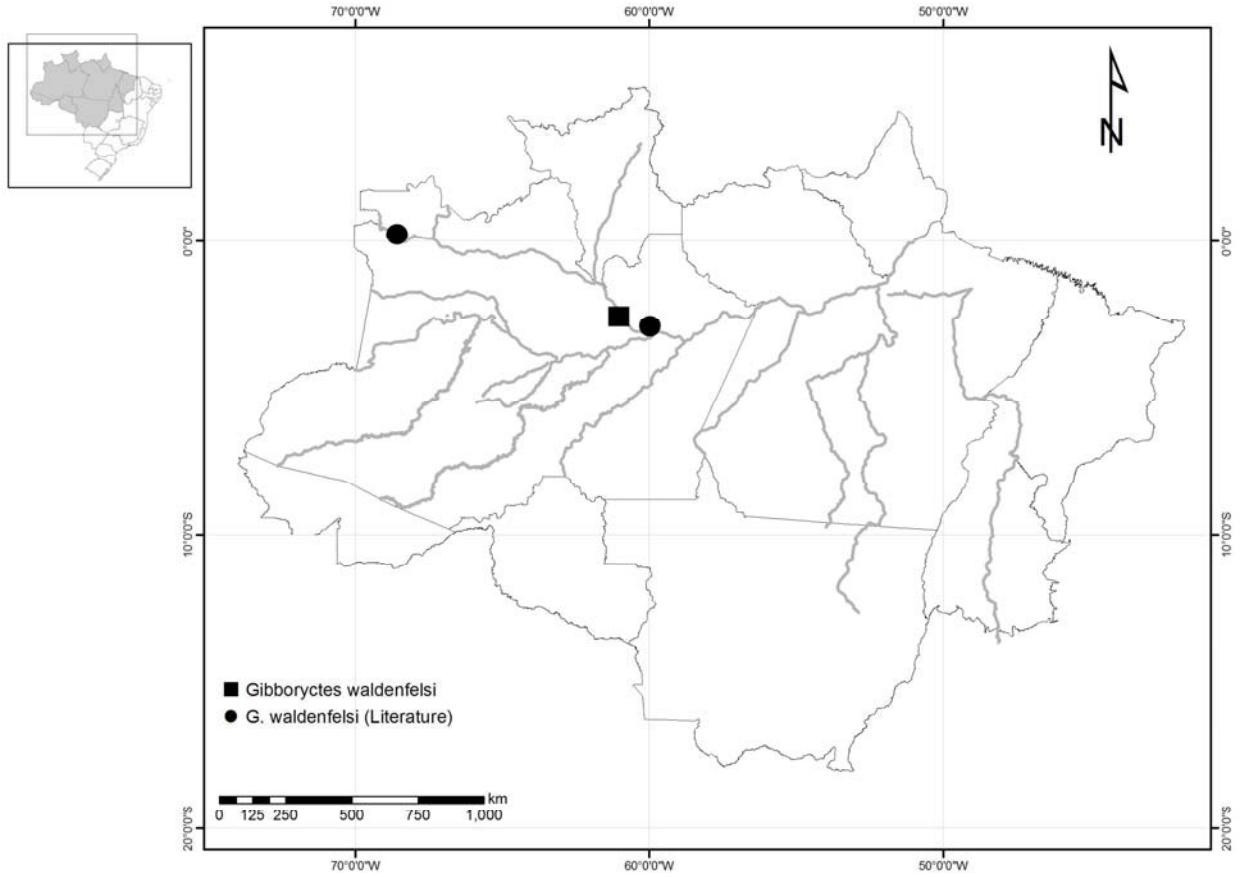


Figure 25. Distribution of *Gibboryctes waldenfelsi* in Brazilian Amazonia.

Males. *Head*: Frons shiny, concave. Surface punctate and rugose, with a conical tubercle (Fig. 22). Eye canthus with apex truncate to almost quadrangular. Clypeus with apex truncate, reflexed, surface shiny. Antenna with 10 segments, club subequal in length to segments 2-7. Mandibles broadly exposed, with 2 large, subequally rounded lobes. *Pronotum*: Surface smooth, with micropunctures. Prominence broad, bifurcate, forming a subtriangular, deep fovea. Projections rounded. Anterior horn long, recurved, apex strongly dilated and weakly bilobed. Base with marginal bead. *Elytra*: Surface with rows of punctate striae; punctures deep, ocellate. Humerus smooth. Lateral margins punctate. *Pygidium*: Surface strongly punctate, setigerous, convex in lateral view; punctures deep, ocellate; setae long, fine. *Legs*: Protibia quadridentate. Posterior tibia with apex crenulate. Posterior tarsus with apex of first tarsomere expanded. *Venter*: Prosternal process short, broad, apex rounded. *Parameres*: Long, slender, slightly contracted towards apex. Apex convex, setigerous medially (Fig. 23-24).

Females. As males except in the following respects: *Head*: Frons with surface coarsely rugose. Tubercle long with apex rounded. Clypeus with apex broadly rounded. *Pronotum*: Horns absent, fovea not deep. Sides with surface punctate. Fovea and anterior angles rugose. *Pygidium*: In lateral view, surface weakly convex.

DIAGNOSIS. *Gibboryctes waldenfelsi* can be distinguished by the deep broad almost triangular fovea on the pronotum, the form of the pronotal horn that is slender and emarginate in the males, and by the bilobed mandibles.

DISTRIBUTION. *Gibboryctes waldenfelsi* is found from southern Panama to the eastern slopes of the Andes in central Peru, the Amazon region of Brazil, and the Guianas. Ratcliffe and Dechambre (1983) noted records for Manaus and Taracuá (Fig. 31). It is rare in research collections.

LOCALITY RECORDS. (Fig. 25) 1 specimen examined (1 male). A specimen was seen from the following collection: CZPB

AMAZONAS (1). Novo Airão (Ramal do Olimpo).

TEMPORAL DISTRIBUTION. January (1).

NOMENCLATURAL REMARKS. Endrödi (1977) described this species in the genus *Strategus.* After examining the holotype, Ratcliffe and Dechambre (1983) concluded that is was a species of *Gibboryctes*, and they transferred it to that genus.

BIOLOGY. *Gibboryctes waldenlfelsi* is very rare in collections, and there is little biological information about its natural history. Adults are attracted to lights (Ratcliffe 2003). In Brazilian Amazonia, this species is associated with semi-humid ombrophilous forests, and areas of seasonal whitewater inundation forest (várzea).

Heterogomphus Burmeister 1847

Heterogomphus Burmeister 1847: 224
Stypotrupes Burmeister 1847: 219 (synonym)
Daemonoplus Thomson 1859: 68 (subgenus)
Baryxenus Bates 1891: 33 (synonym)
Syneterogomphus Prell 1912: 53 (synonym)
Ortheterogomphus Prell 1912:103 (synonym)
Heterogomphidium Prell 1912: 105 (synonym)
Hoplitogomphus Prell 1912: 123 (synonym)
Dineterogomphus Prell 1912: 129 (synonym)
Psileterogomphus Prell 1912: 141 (synonym)
Neobaryxenus Prell 1912: 148 (synonym)
Anoplogomphus Prell 1912: 149 (synonym)
Notheterogomphus Prell 1912: 156 (synonym)
Tracheterogomphus Prell 1912: 161 (synonym)

Type species: *Heterogomphus julus* Burmeister, 1847.

Heterogomphus species may be recognized by quadridentate protibiae, teeth of the protibia directed obliquely forward, males usually with a large head horn, females with one or two tubercles on the head, and prosternal process long and stout. Adults are nocturnal, and many are attracted to lights at night. The larvae probably feed on organic debris in the soil (Ratcliffe 2003). The genus consists of 47 species (Dechambre 1986, 1998a), of which 21 species are known from Brazil with four of them occurring in the Brazilian Amazon.

Key to the species of adult *Heterogomphus* of the Brazilian Amazon

1. Mandibles simple, with a large blade. Clypeal apex with a median notch forming 2 lobes (Fig. 41). Each side of pronotum with a tuberculiform process **2**
— Mandibles bidentate, teeth subequal in size, with rounded apex. Clypeus truncate or with 2 teeth. Sides of pronotum without structures or tubercles **3**

2(1). Apex of metatibia crenulate. Pronotal prominence high, apex bilobed, slightly curved. Sides of pronotum with a conical tubercle. Fovea of pronotum broad, smooth .... ***H. aidoneus* (Perty)**
— Apex of metatibia usually with a row of thick spinules (Fig. 42). Pronotal prominence high, projecting forward, apex with a notch forming 2 broad lobes. Sides of pronotum with a

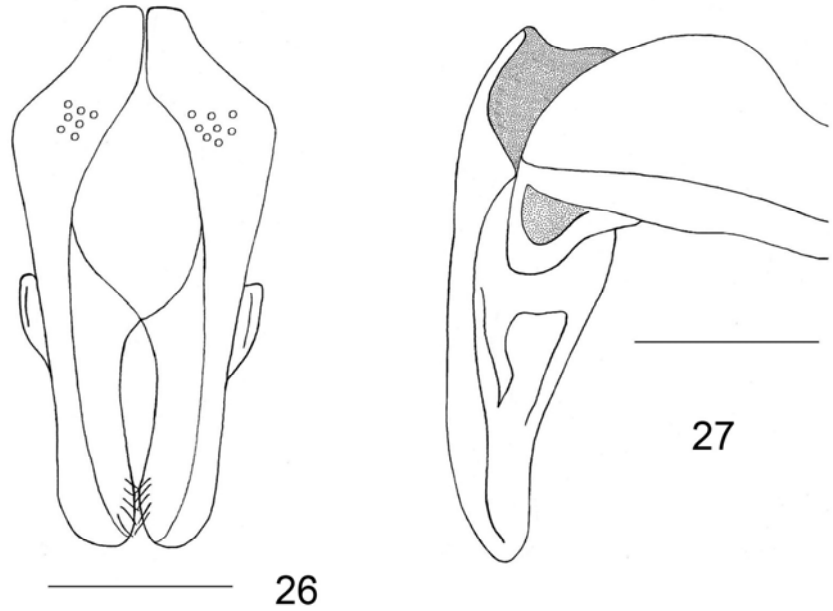


Figure 26-27. *Heterogomphus aidoneus*. **26)** Parameres frontal view. **27)** Parameres lateral view (scale line: 2 mm).

tuberculiform process. Fovea of pronotum broad, deep, surface densely setose .... ***H. ulysses*** **Burmeister**

3(1). Apex of metatibia crenulate, without teeth. Prosternal process short, conical, apex slightly acuminate. Pronotal prominence higth, projecting at 90º from the body, apex with 2 quadrangular lobes. Head horn long, curved, apex slightly bilobed ..... ***H. eteocles*** **Burmeister**

— Apex of metatibia with 2 teeth (Fig. 35). Prosternal process long, laminate, apex quadrangular. Pronotal prominence high, seemingly forming 4 lobes, apex bilobed with central notch. Sides of pronotum with small rounded lobe. Head horn short, apex acuminate .... ***H. telamon*** **(Burmeister)**

Heterogomphus aidoneus **(Perty 1830)**
(Fig. 26-28)

Heterogomphus aidoneus Perty 1830: 45
Scarabaeus aidoneus Perty 1830: 45 (synonym)
Hoplitogomphus piliger Prell 1912: 127 (synonym)
Hoplitogomphus affinis Prell 1912: 127 (synonym)

DESCRIPTION. Length: 41.5-55.5 mm. Width: 24.5-26.0 mm. Color: Dark reddish brown to black; pronotum brown to black

Males. *Head*: Frons with moderately long horn strongly curved, robust, apex rounded; sides of horn with micropunctures. Eye canthus with apex rounded, surface moderately wrinkled. Clypeus reflexed, strongly emarginate, apex with 2 subquadrangular lobes with a notch at center. Antenna with 10 segments, club subequal in length to segments 2-7. Mandibles simple, tooth long, apex rounded. *Pronotum*: Prominence long, high; apex bilobed, each lobe with apex rounded, weakly curving forward. Sides with a conical, tuberculiform process above lateral margin, weakly curved, apex rounded. Fovea broad, surface smooth. *Elytra*: Sutural stria impressed. Surface with 1-2 rows of punctures, punctures small, sparse; lateral margin weakly wrinkled. *Pygidium*: Surface finely punctate to moderately wrinkled. Posterior margin with a transverse band of long, reddish brown setae. Angles weakly rugose. In lateral view,

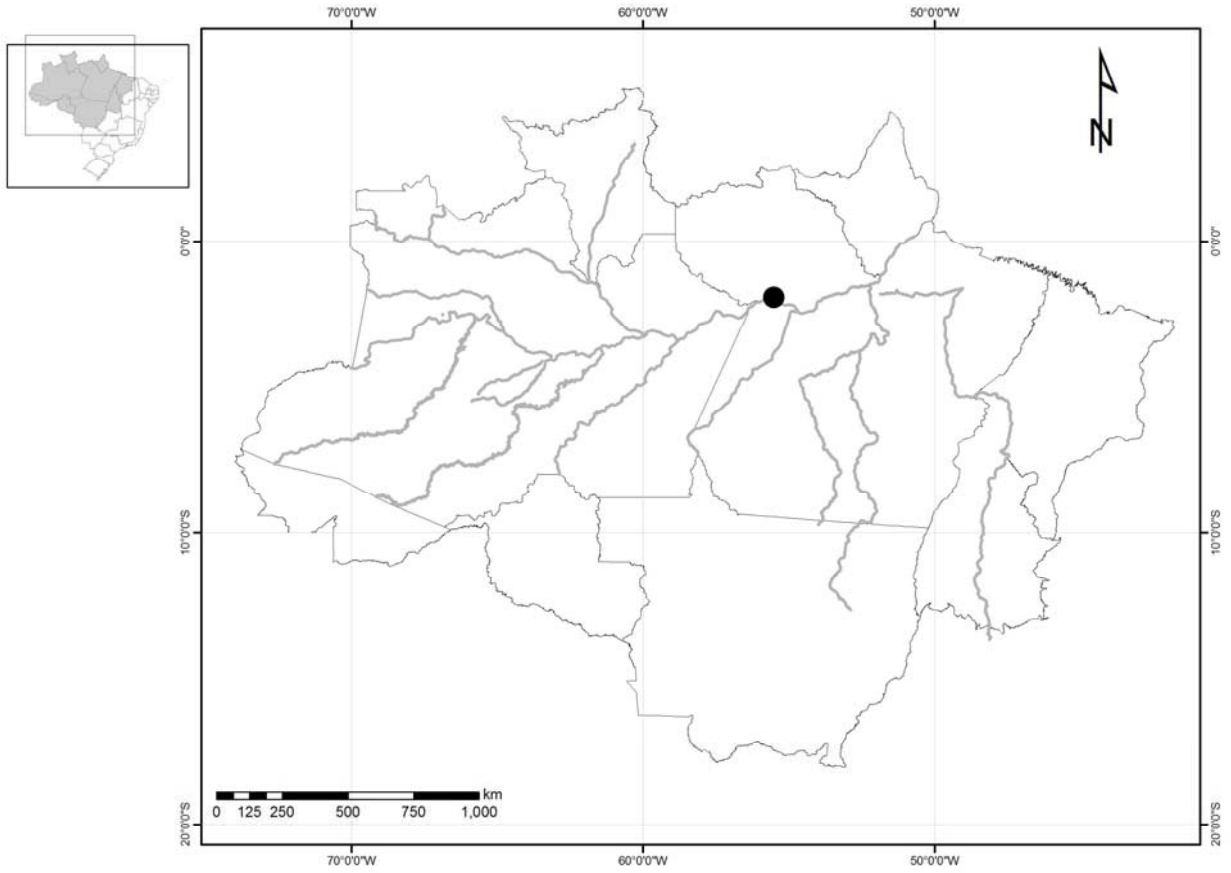


Figure 28. Distribution of *Heterogomphus aidoneus* in Brazilian Amazonia.

surface convex. *Legs*: Protibia quadridentate. Apex of posterior tibia strongly crenulate. Apex of first tarsomere of posterior tarsus long, subtriangular. *Venter*: Prosternal process high, densely setigerous, apex rounded to quadrangular. *Parameres*: Long, slender, apex weakly contracted, setigerous in the central region. Surface or posterior region with sparse punctures (Fig. 26-27).

Females. Females unavailable.

DIAGNOSIS. Males of *H. aidoneus* can be distinguished by a broad, large pronotal fovea, a high pronotal prominence projecting upward that is bilobed at the apex, and by a conical tubercle on each side of the pronotum.

DISTRIBUTION. *Heterogomphus aidoneus* occurs in Ecuador, southern Brazil, Paraguay, and Argentina (Endrödi 1976). The specimen listed below from Pará state represents a NEW RECORD from the Brazilian Amazon.

LOCALITY RECORDS. (Fig. 28) 2 specimen examined (2 males). Specimens were seen from the following collection: MZSP.

PARÁ (2). Óbidos.

TEMPORAL DISTRIBUTION. No data

BIOLOGY. Little is known about the biology of this species. Adults of *H. aidoneus* construct burrows at the base of the stalks and on foliage of bamboo plants, *Chusquea ramosissima* Lindm. (Poaceae) in particular, and they feed on the sap that comes from the stems (Keller 2003). The sap flowing from stems

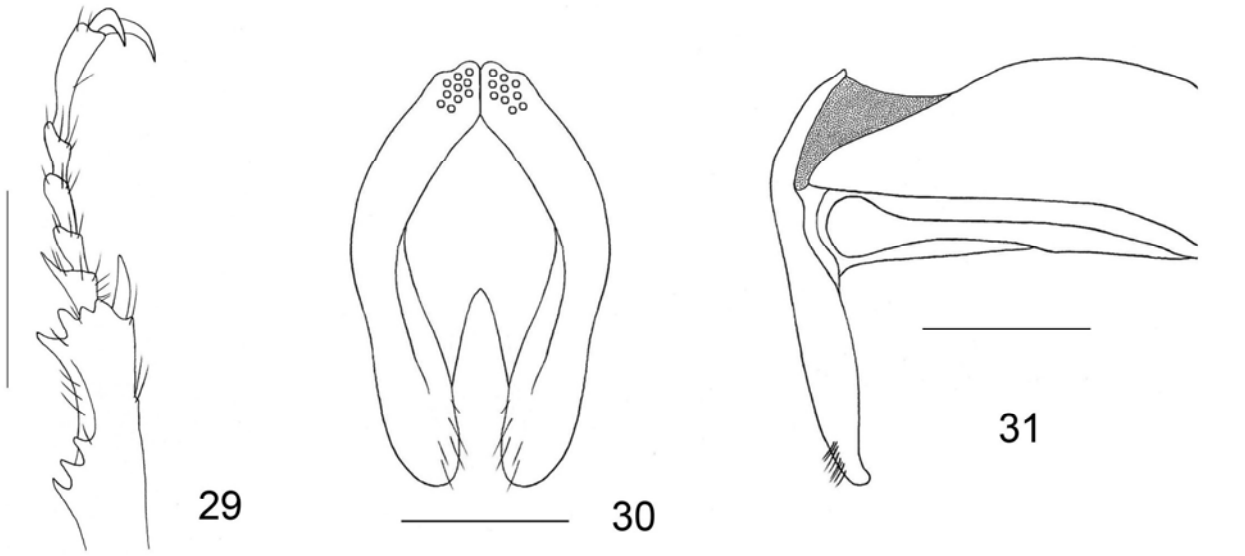


Figure 29-31. *Heterogomphus eteocles*. **29)** Metatarsus. **30)** Parameres frontal view. **31)** Parameres lateral view (scale line: 2 mm).

damaged by the scarabs is also a food resource for adults of *Lasiodactylus kelleri* Cline (Coleoptera: Nitidulidae). The burrow microhabitat provided by these dynastines is an ideal refuge for nitidulids due to its proximity to food and as a refuge from predation (Cline and Carlton 2004).

In the Brazilian Amazon, this species has been collected from an area of seasonal whitewater inundation forest (várzea).

***Heterogomphus eteocles* Burmeister 1847**
(Fig. 29-32)

Heterogomphus eteocles Burmeister 1847: 228
Heterogomphus polynices Prell 1912: 109 (synonym)

DESCRIPTION. Length: 41.5-55.5 mm. Width: 24.5-26.0 mm. Color: Dark reddish brown to black; pronotum brown to black

Males. *Head*: Frons with long, recurved horn, posterior margin of horn with a small prominence, apex narrowly truncate, slightly bilobed, surface densely rugose. Eye canthus with apex rounded, surface punctate and rugose. Antenna with 10 segments, club subequal in length to segments 2-7. Mandibles with 2 long, subequal teeth, apices of teeth rounded. *Pronotum*: Prominence long, high, projecting at 90° from the body; apex bifurcate forming 2 small quadrangular horns, horns projecting forward. Sides with broad rugose area in basal half. Fovea broad, surface smooth with small punctures. *Elytra*: Impressed sutural stria present. Surface usually smooth with small, sparse punctures, lateral margin weakly rugose. *Pygidium*: Surface finely punctate and rugose with a transverse band of long, reddish brown setae on posterior margin. Angles weakly rugose. Surface convex in lateral view. *Legs*: Protibia quadridentate. Apex of posterior tibia strongly crenulate. Apex of first tarsomere of posterior tarsus subtriangular, elongate, spur-like (Fig. 29). *Venter*: Prosternal process short to moderate in length, conical, apex acuminate. *Parameres*: Oval, contracted toward apices, sides curved. Posterior region with deep punctures. Apex setigerous on inner margin (Fig. 30-31).

Females. Females unavailable.

DIAGNOSIS. Adults of *H. eteocles* can be recognized by the pronotal horn projecting at 90° from the body, bifurcate at the apex with two quadrangular lobes. The frontal horn is long, recurved, and weakly bilobed.

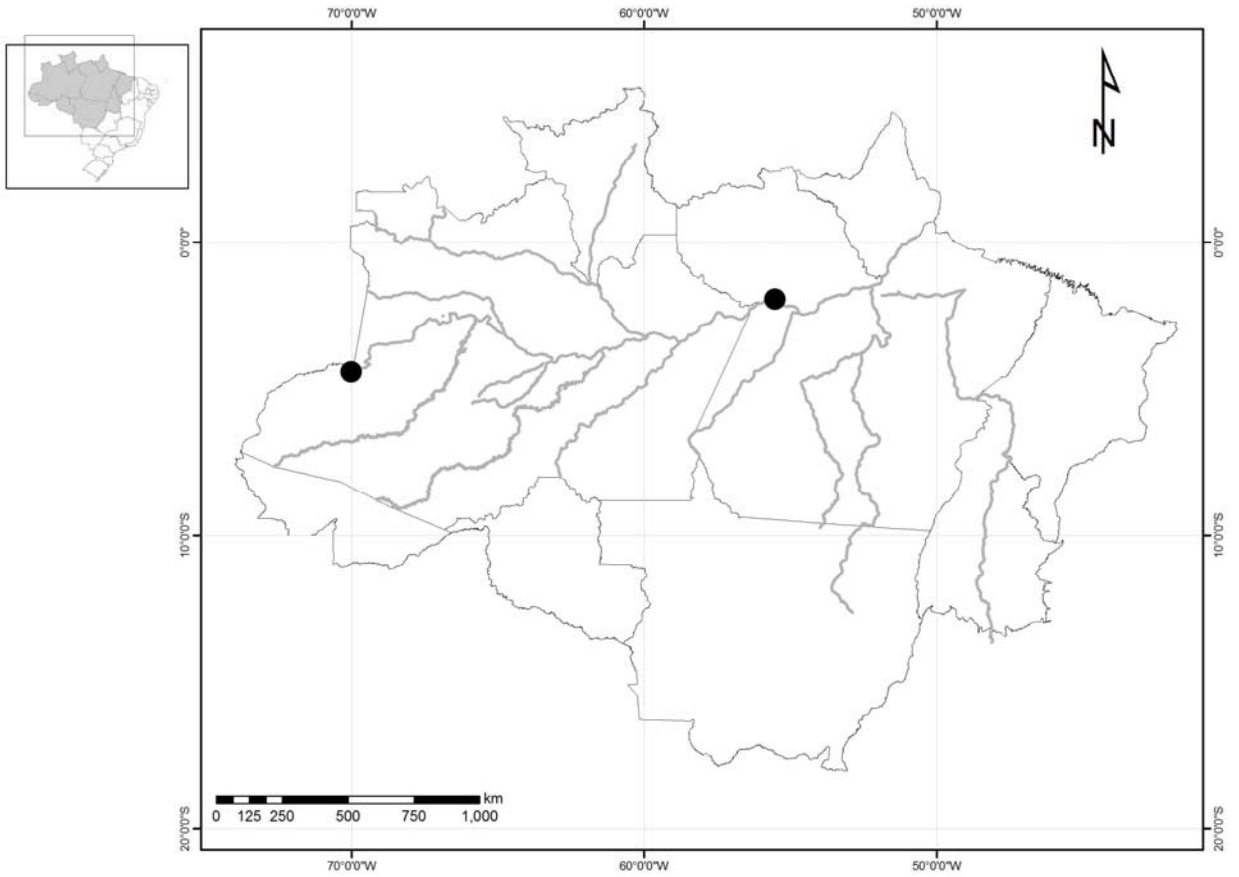


Figure 32. Distribution of *Heterogomphus eteocles* in Brazilian Amazonia.

DISTRIBUTION. *Heterogomphus eteocles* is distributed only in South America, occurring from southern Brazil to northern Argentina. The specimens listed below from Amazonas and Pará states represent NEW RECORDS from the Brazilian Amazon.

LOCALITY RECORDS. (Fig. 32) 2 specimens examined (2 males). Specimens were seen from the following collection: MZSP.

AMAZONAS (1): Benjamin Constant (Rio Javari). PARÁ (1): Óbidos.

TEMPORAL DISTRIBUTION. April (2)

BIOLOGY. Little is known about the biology of this species. *Heterogomphus eteocles* has been reported as a pest of *Chusquea ramosissima* Lindm. (Poaceae) in Argentina (Keller 2003). In Brazilian Amazonia, adults have been collected from areas of seasonal whitewater inundation forest (várzea).

***Heterogomphus telamon* (Burmeister 1847)**
(Fig. 33-38)

Stypotrupes telamon Burmeister 1847: 210
Syneterogomphus sternbergi Prell 1912: 55 (synonym)

DESCRIPTION. Length: 39.2-51.4 mm (males); 40.7-50.0 mm (females). Width: 19.2-27.0 mm (males); 21.9-25.8 mm (females). Color: Black.

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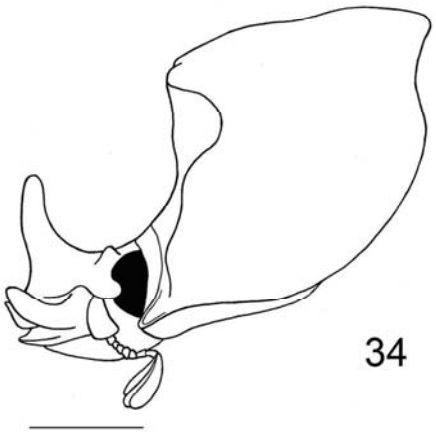

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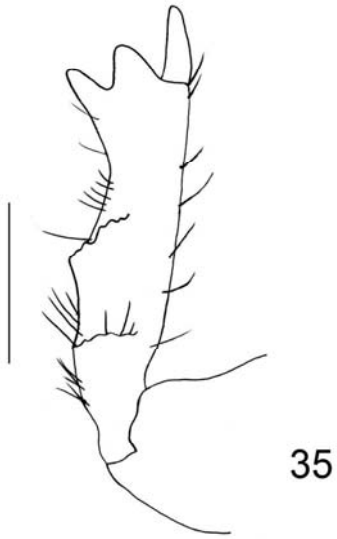

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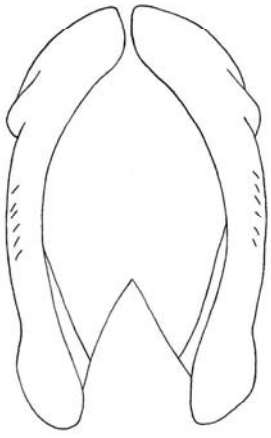

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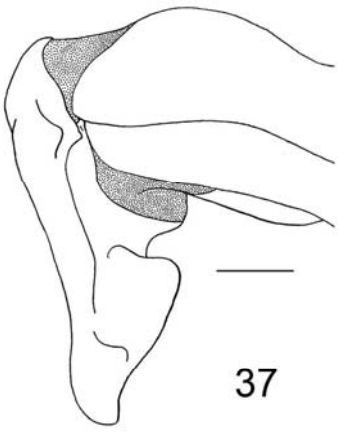

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Figure 33-37. *Heterogomphus telamon*. **33)** Habitus. **34)** Male head and pronotum (scale line: 5 mm). **35)** Metatibia (scale line: 5 mm). **36)** Parameres frontal view. 37) Parameres lateral view (scale line: 1 mm).

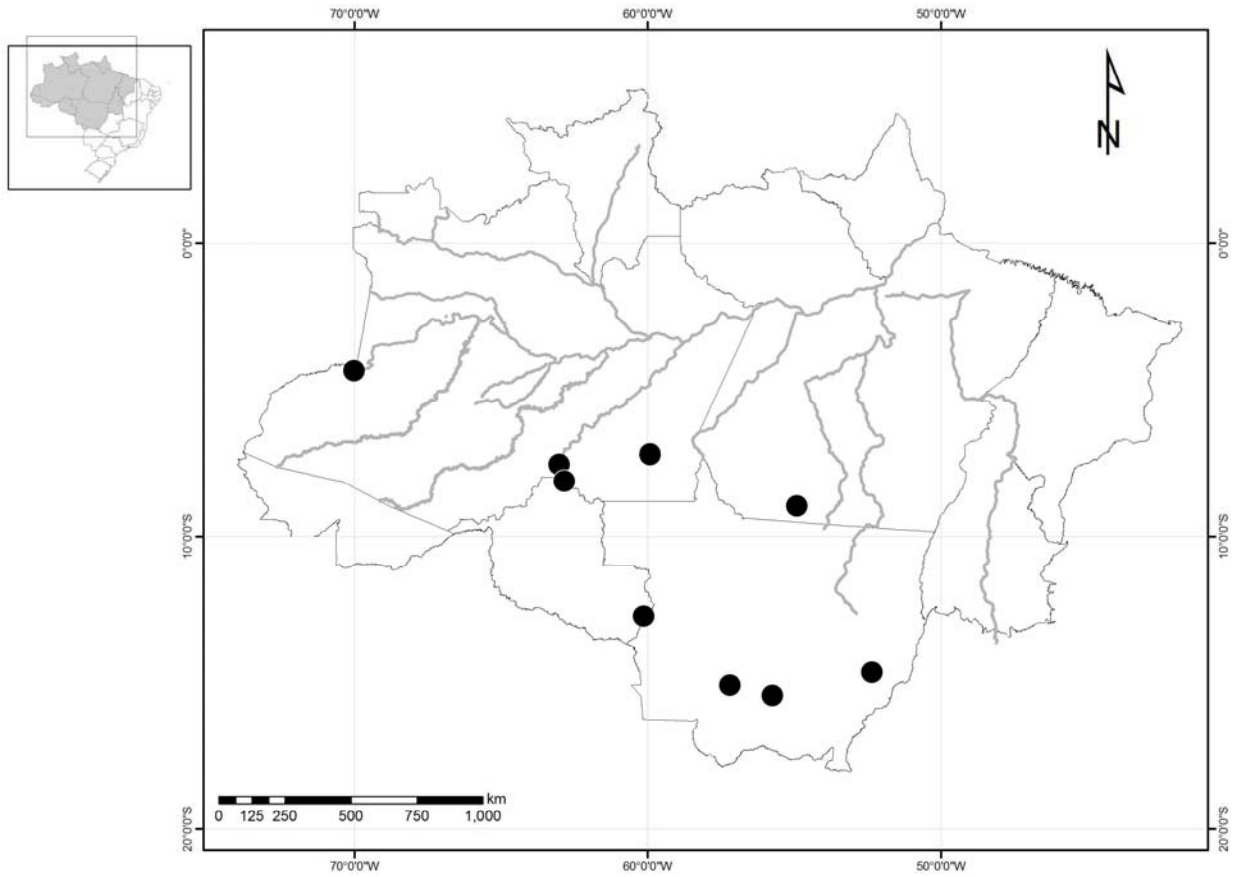

Figure 38. Distribution of *Heterogomphus telamon* in Brazilian Amazonia.

Males. *Head*: Frons with moderately short, recurved horn, apex acuminate (Fig. 34). Eye canthus with apex slightly narrowed, surface rugose. Clypeus reflexed, truncate, apex broad, surface rugose. Antenna with 10 segments, club subequal in length to segments 2-7. Mandibles bidentate, teeth with rounded apices, external tooth longer. *Pronotum*: Majors with long, broad prominence, apex bilobed; sides with small, rounded lobe forming 2 small fovea in anterior region (Fig. 34). Surface of posterior half smooth, with sparse punctures, anterior half rugose. Minors with typical reduction in size of frontal horn and pronotal prominence. *Elytra*: Impressed sutural stria present. Surface usually smooth, occasionally with small punctures on the lateral margins. *Pygidium*: Surface finely punctate, without setae. In lateral view, surface strongly convex. *Legs*: Protibia quadridentate. Apex of posterior tibia with 2 teeth (Fig. 35). First tarsomere of posterior tarsus long, quadrangular. *Venter*: Prosternal process long, broad, laminar, apex quadrangular with long, thick setae. *Parameres*: Oval, weakly contracted forward apices. Basal half with rounded teeth (Fig. 36-37).

Females. As males except in the following respects: *Head*: Frons with surface strongly rugose, with a small tubercle with acuminate apex. *Pronotum*: Two small tubercles behind anterior margin. Surface of anterior half strongly rugose. Lateral margins strongly punctate. *Pygidium*: Apex with small setae, weakly convex in lateral view.

DIAGNOSIS. *Heterogomphus telamon* may be distinguished from other *Heterogomphus* species by the long, laminar prosternal process, apex of posterior tibiae bidentate, and the pronotal prominence apparently forming four lobes with two small fovea.

DISTRIBUTION. There are little data about the distribution of *H. telamon*. Endrödi (1985) recorded this species from Brazil and Surinam. The specimens listed below from Amazonas state represents NEW RECORD from the Brazilian Amazon.

LOCALITY RECORDS. (Fig. 38) 16 specimens examined (3 males, 13 females). Specimens were seen from the following collections: INPA, CZPB.

AMAZONAS (16): Barcelos (Rio Unini, Cachoeira Boca da Onça), Coari (Rio Urucu), Manaus, Novo Airão (Ajarú), Novo Aripuanã, Itacoatiara (Fazenda Aruanã, Am 010 km 215), Parque Nacional do Jaú, São Gabriel da Cachoeira (Querari).

TEMPORAL DISTRIBUTION. January (1), February (1), April (1), May (2), June (1), July (4), August (2), September (3), October (1).

BIOLOGY. Adults are nocturnal and can be attracted to lights. In Brazilian Amazonia, this species has been collected from semi-humid ombrophilous forests and foodplain areas at elevations of 22-115 meters.

***Heterogomphus ulysses* Burmeister 1847**
(Fig. 39-45)

Heterogomphus ulysses Burmeister 1847: 232

DESCRIPTION. Length: 47.2-52.5 mm (males); 46.7-49.1 mm (females). Width: 22.7-27.3 mm (males); 21.4-24,5 mm (females). Color: Dark reddish brown to black.

Males. *Head*: Frons with long, recurved horn, sides of horn subparallel, apex rounded and truncate (Fig 40). Eye canthus with rounded apex, surface rugose, anterior margin weakly crenulate. Clypeus reflexed, truncate, apex broad with notch at center (Fig. 41), surface smooth to punctate. Antenna with 10 segments, club subequal in length to segments 2-7. Mandibles with a single, large tooth with rounded apex. *Pronotum*: Majors with broad, high prominence, posterior surface convexly rounded; apex cariniform, with emargination at center. Sides with broad, tuberculiform process (Fig. 40). Base with marginal bead. Surface of fovea with small, sparse, setigerous punctures; setae dense, moderately long, reddish brown. Lateral margins rugose. Minors with frontal horn and pronotal prominence variably reduced. *Elytra*: Impressed sutural stria present. Surface occasionally with weak furrows in the central area. Deep punctures present near humerus. Sides with irregular rows of ocellate and deep punctures behind humerus. Apex with small setae, reddish brown setae. *Pygidium*: Surface rugopunctate, base with transverse band of long, dense, reddish brown setae. Apical half smooth, densely setigerous in small specimens. *Legs*: Protibia quadridentate. Apex of posterior tibia crenulate, with a row of thick spinules (Fig. 42). First tarsomere of posterior tarsus long, quadrangular. *Venter*: Prosternal process long, apex rounded, densely setose; setae long, reddish brown. *Parameres*: Elongated, oval, strongly contracted forward apices (Fig. 43-44).

Females. As males except in the following respects: *Head:* Frons with small, conical tubercle. Clypeal surface strongly punctate. Mandibles smaller in size. *Pronotum:* Surface of anterior half strongly rugose, posterior half smooth, with sparse punctures. *Pygidium:* Apex with small, reddish brown setae. In lateral view, basal half convex, anterior half weakly concave.

DIAGNOSIS. *Heterogomphus ulysses* may be distinguished by the following combination of characters: apex of metatibia with a row of spinules, sides of pronotum with a small tuberculiform process, pronotal fovea deep and densely setigerous, frontal horn long with bilobed apex.

DISTRIBUTION. *Heterogomphus ulysses* is known from Colombia, Perú, and Brazil (Endrödi 1976).

LOCALITY RECORDS. (Fig. 45) 60 specimens examined (32 males, 28 females). Specimens were seen from the following collections: INPA, MPEG, MZSP, UNSM.

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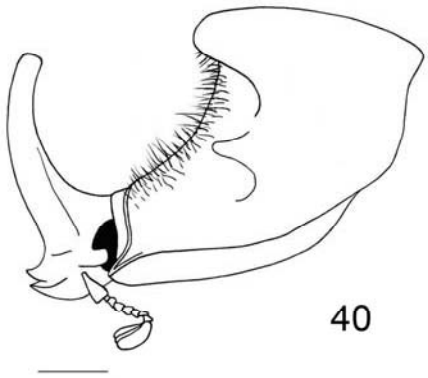

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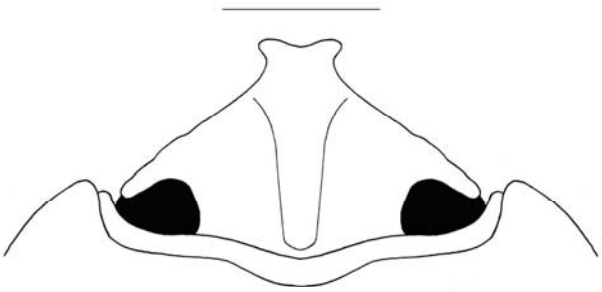

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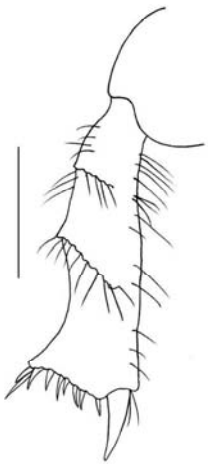

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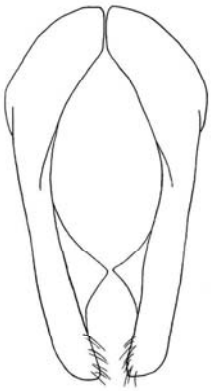

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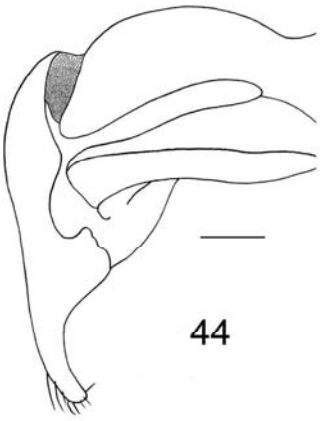

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Figure 39-44. *Heterogomphus ulysses*. **39)** Habitus. **40)** Male head and pronotum (lateral view). **41)** Male head (dorsal view). **42)** Metatibia (scale line: 5 mm). **43)** Parameres frontal view. **44)** Parameres lateral view (scale line: 1 mm).

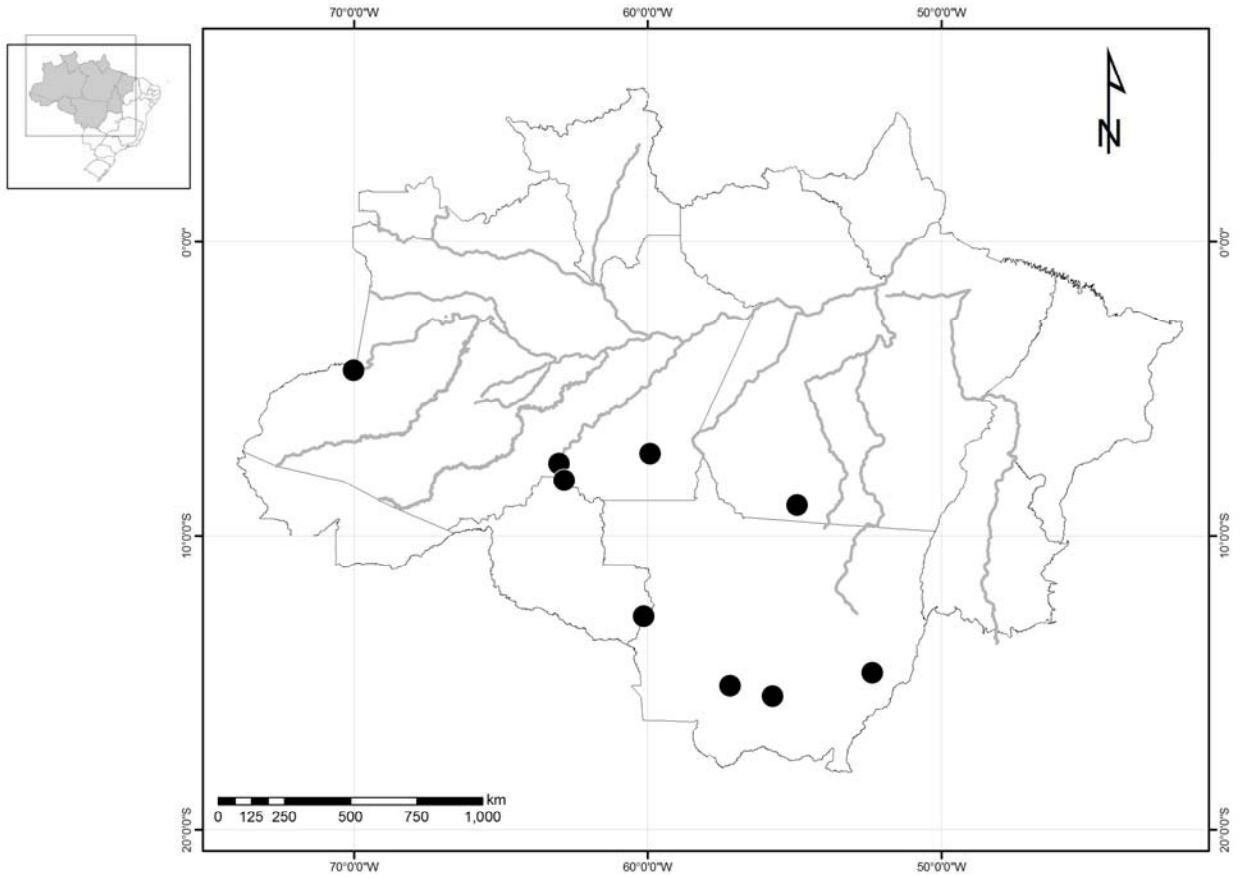

Figure 45. Distribution of *Heterogomphus ulysses* in Brazilian Amazonia.

AMAZONAS (4): Apuí (Posto Pioneiro), Benjamin Constant (Rio Javari), Humaitá. MATO GROSSO (5): Chapada dos Guimarães (Fazenda Buriti), Barra dos Bugres (Reserva Ecológica Serra das Araras), Xavantina. PARÁ (2): Cachimbo. RONDÔNIA (49): Vilhena, Calama.

TEMPORAL DISTRIBUTION. February (51), March (2), May (1), September (2), October (2), November (2).

BIOLOGY. Nothing is known of the life history of this species**.** In Brazilian Amazonia, *H. ulysses* has been collected from semi-humid ombrophilous forests and floodplain areas at elevations of 60-600 meters.

Megaceras Hope 1837

Megaceras Hope 1837: 82

Type species: *Scarabaeus choriaeus* Olivier 1789

Species of *Megaceras* are characterized by tridentate protibiae, frons with a single horn in the males or a single tubercle in the females, prosternal process present, smooth elytra, and mandibles distinctly bidentate and exposed. Little is known of the life history of these beetles. Adults are active at night and the larvae probably live in rotten wood or in soil feeding on organic matter (Ratcliffe 2003). The genus contains 19 species (Endrödi 1985; Dechambre 1981, 1998b,c; Ratcliffe 2007) with distribution in Central

America and South America, where 6 species are known from Brazil; four of them occur in the Brazilian Amazon.

Key to the species of adult *Megaceras* of Brazilian Amazonia

1. Apex of clypeus with 2 teeth (Fig. 59). Mandibles with 2 subequal teeth with acuminate apex ... . ***M. philoctetes* (Olivier)**
— Apex of clypeus truncate or slightly emarginate. Mandibles with 2 teeth different in size **2**

2(1). Elytra with sutural stria slightly impressed or absent. Head horn with apex rounded or slightly acuminated. Pygidium of females with strong transverse furrow (Fig. 54), anterior half concave in lateral view ..... ***M. laevipenne* Prell**
— Elytra with sutural stria impressed. Head horn with apex slightly bilobed or strongly bifurcate. Pygidium of females covex in lateral view **3**

3(2). Apex of head horn slightly bilobed. Horns of pronotal prominence subparallel, curved down. Pronotum of females with 2 tubercles. Pronotum of females with 2 tubercles behind anterior margim and with a slight furrow between them ..... ***M. crassum* Prell**
— Apex of pronotal horn bifurcate. Horns of pronotal prominence divergent, strongly curved down. Pronotum of females with 2 conical tubercles behind anterior margin, without slight furrow between them ..... ***M. stuebeli* Kirsch**

***Megaceras crassum* Prell 1914**
(Fig. 46-50)

Megaceras crassum Prell 1914: 213
Megaceras punctatostriatum Prell 1934: 57 (synonym)

DESCRIPTION. Length: 37.1-42.5 mm (males); 29.5 mm (females). Width: 23.1-25.1 mm (males); 18.2 mm (females) (Species range for females. Length: 31.0-38 mm (Endrödi 1985)). Color: Black.

Males. *Head*: Frons with recurving horn; horn weakly bilobed at apex, posterior margin of horn with small, tooth-like swelling near apex (Fig. 46). Eye canthus with rounded apex, anterior margin weakly crenulate. Clypeus truncate, reflexed, surface punctate (Fig. 47). Antenna with 10 segments, club subequal in length to segments 2-7. Mandibles with 2 teeth, external tooth elongated, internal tooth truncate with apex subquadrangular. *Pronotum*: Prominence moderately high, bifurcated, apex with 2 small, subparallel horns, curving downward (Fig. 46). Surface almost smooth, opaque, with sparse punctures, lateral margins with a band of spaced rugae, rugae connected to *areola apposita*. *Scutellum*: Smooth, triangular, apex rounded. *Elytra*: Smooth or with micropunctures. Sutural stria impressed, wrinkled. *Pygidium*: Surface punctate to finely punctate. Base with a band of long setae. Lateral angles finely rugose. In lateral view, surface convex. *Legs*: Protibia tridentate. Apex of posterior tibia with a spur. First tarsomere of posterior tarsus triangular, apex extend into long spine. *Venter*: Prosternal process high, slightly convex, apex rounded. *Parameres*: Circular, sides strongly curved, apex slightly curved (Fig. 48-49).

Females. As males except in the following respects: *Head*: Frons with single, strong, conical tubercle at middle, surface rugose. *Pronotum*: Surface smooth, 2 strong, acuminate tubercles behind anterior margin, with a slight furrow between them, sides punctate.

DIAGNOSIS. Adults of *M. crassum* can usually be recognized by the small size of the body, horns of pronotum parallel to subparallel, and the circular form of parameres. Males of *M. crassum* could be confused with the males of *M. laevipenne*, and only the form of the parameres can separate these two species.

DISTRIBUTION. *Megaceras crassum* is widely distributed in Ecuador, Peru, Colombia, Bolivia and southern Brazil. The specimens listed below from Amazonas and Pará states represent NEW RECORDS from the Brazilian Amazon.

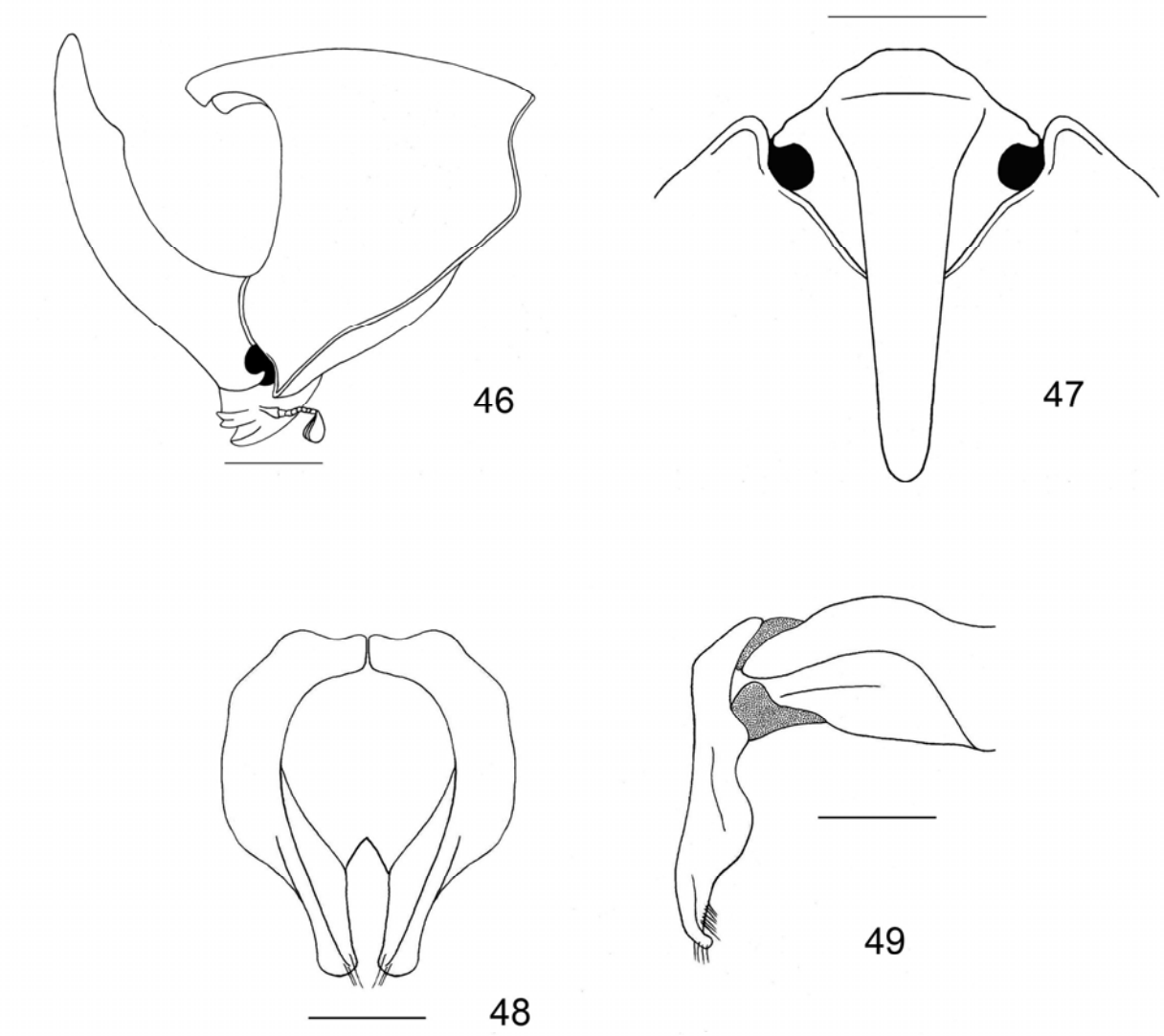

Figure 46-49. *Megaceras crassum*. **46)** Male head and pronotum (lateral view). **47)** Male head (dorsal view) (scale line: 5 mm). **48)** Parameres frontal view. **49)** Parameres lateral view (scale line: 2 mm).

LOCALITY RECORDS. (Fig. 50) 7 specimens examined (6 males, 1 female) Specimens were seen from the following collections: MZSP and UNSM.

AMAZONAS (6): Benjamin Constant (Rio Javarí); Hupda Maku (Serra dos Porcos), Taracuá. PARÁ (1): Cachimbo.

TEMPORAL DISTRIBUTION. June (2), July (2), August (1), September (1).

BIOLOGY. Little is known about the life history of this species. According to Dufour (1987), the Tukanoan Indians of the northwest Amazon in the Colombian Vaupes region eat the larvae of *M. crassum,* and these are preferred over the adults. In Brazilian Amazonia, this species has been collected from semi-humid ombrophilous forests and areas of seasonal whitewater inundation forest (várzea) at elevations of 60-400 meters.

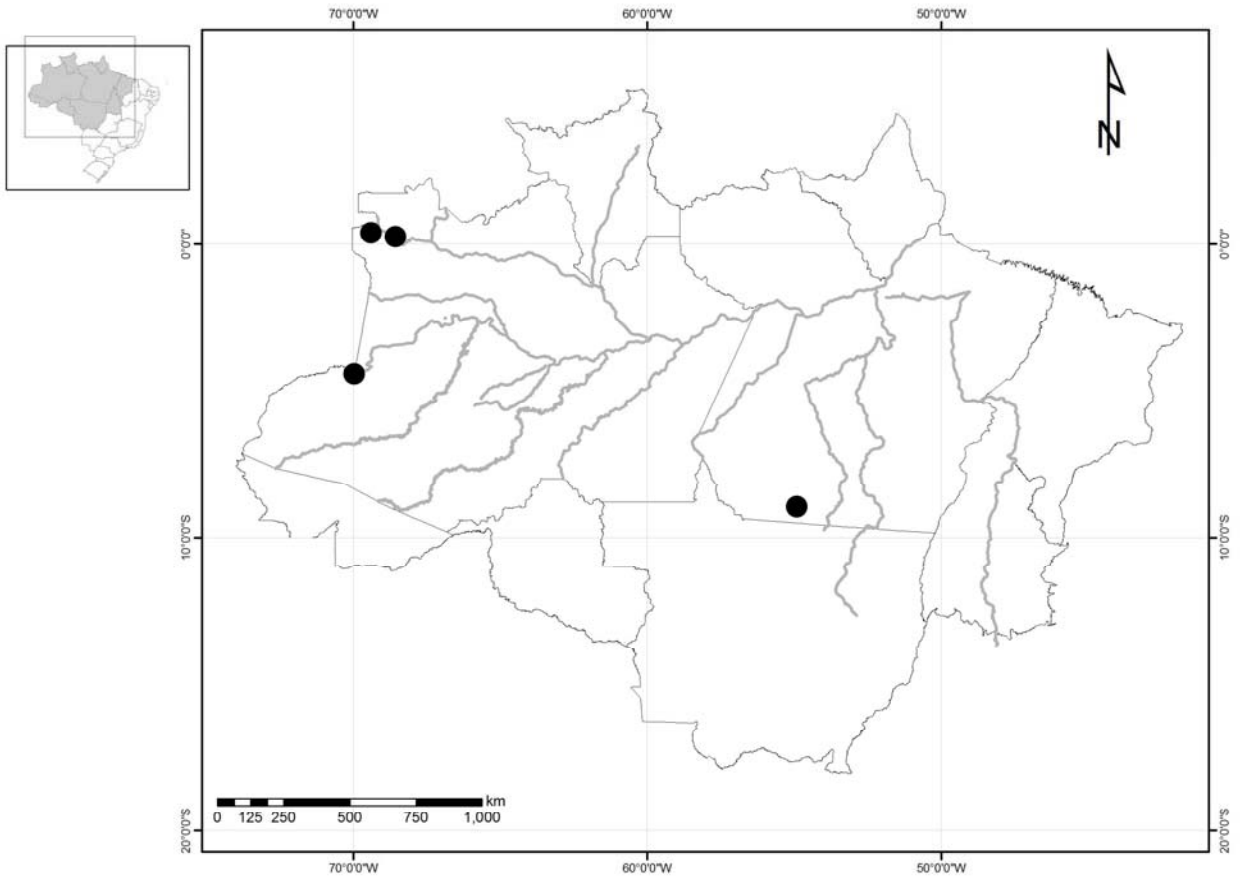

Figure 50. Distribution of *Megaceras crassum* in Brazilian Amazonia.

***Megaceras laevipenne* Prell 1914**
(Fig. 51-57)

Megaceras laevipenne Prell 1914: 214

DESCRIPTION. Length: 30.4-35.3 mm (males); 29.3-32.0 mm (females). Width: 18.6-19.7 mm (males); 17.9-19.1 mm (females). Color: Black.

Males. *Head*: Frons with long, recurved horn, posterior margin of horn with small, tooth-like swelling near apex, apex rounded (Fig. 52). Eye canthus with rounded apex, anterior margin weakly contracted, surface rugose. Clypeus broad, apex rounded (Fig. 53), sometimes with the border weakly crenulate, surface punctate. Antenna with 10 segments, club subequal in length to segments 2-7. Mandibles with 2 teeth, external tooth larger, broad, apex rounded; internal tooth with narrow apex. *Pronotum*: Protuberance high, long, bifurcated; apex with 2 small, subparallel to weakly divergent horns (Fig. 52). Lateral margins with a band of spaced rugae, rugae connected to *areola apposita*. *Scutellum*: Smooth or with sparse deep punctures, triangular. *Elytra*: Surface smooth, without sutural stria, margins with sparse punctures. *Pygidium*: Surface weakly punctate, basal half with a band of reddish brown setae. Lateral angles finely punctate. *Legs*: Protibia tridentate. Apex of posterior tibia with a spur. First tarsomere of posterior tarsus triangular, apex extend into long spine. *Venter*: Prosternal process long, weakly laminar, apex rounded with long setae, base with small prominence. *Parameres*: Long and slender, convex, lateral margins with small tooth near apex, inner sides setose (Fig. 55-56).

Females. As males except in the following respects: *Head*: Frons with a small, conical tubercle, surface rugose. *Pronotum*: Surface with small punctures, with 2 small tubercles behind anterior margin. *Pygidium*: Surface finely punctate, with a strong transverse furrow (Fig. 54).

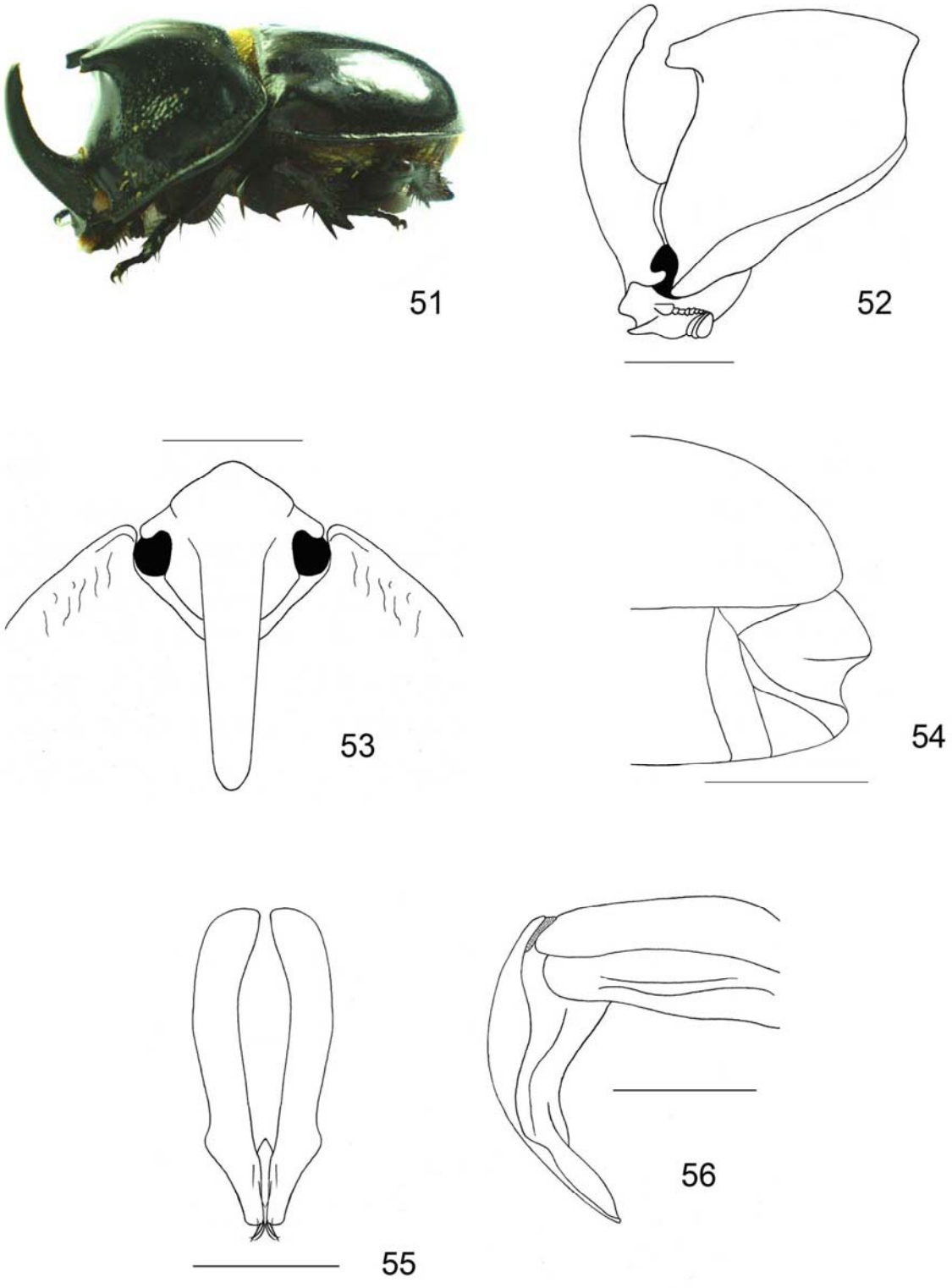

Figure 51-56. *Megaceras laevipenne*. **51)** Habitus. **52)** Male head and pronotum (lateral view). **53)** Male head (dorsal view). **54)** Female pygidium (scale line: 5 mm). **55)** Parameres frontal view. **56)** Parameres lateral view (scale line: 2 mm).

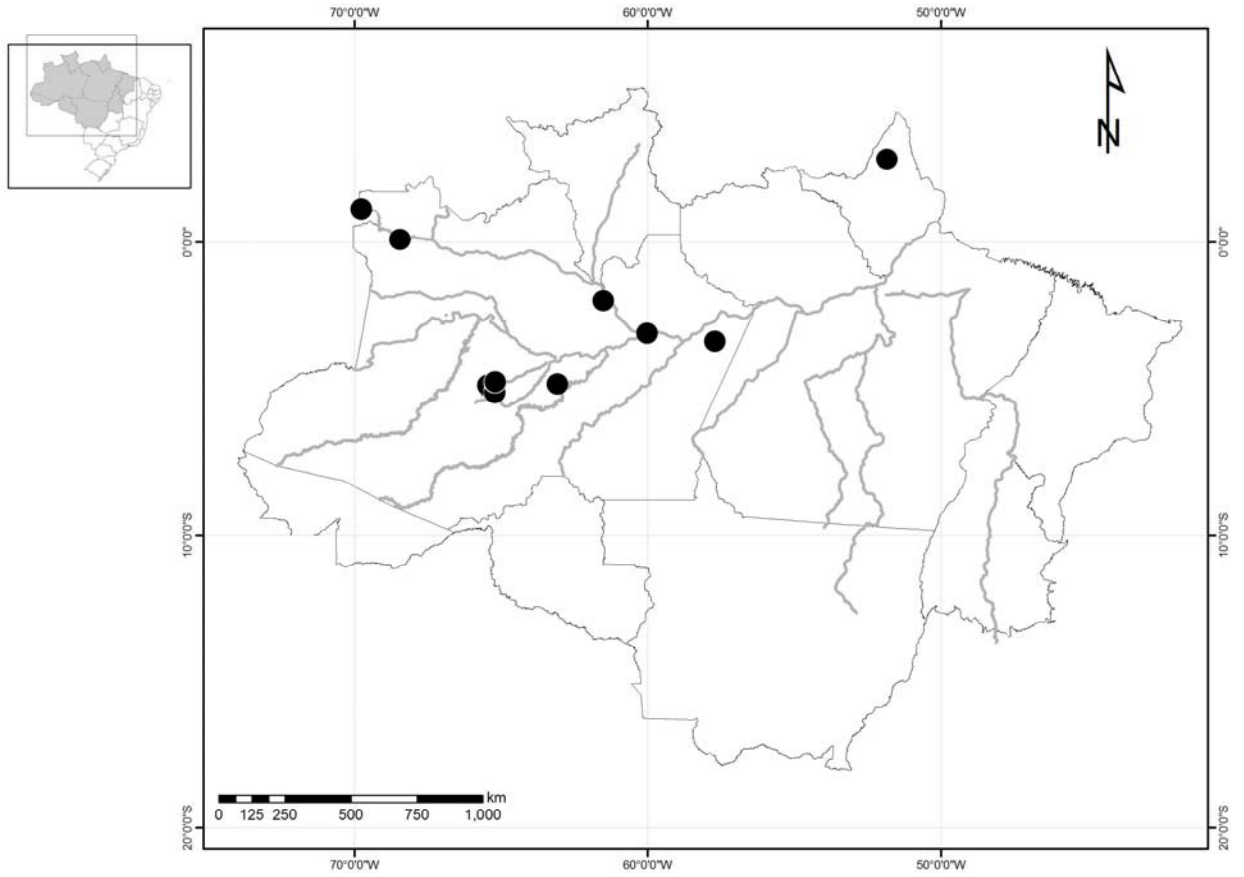

Figure 57. Distribution of *Megaceras laevipenne* in Brazilian Amazonia.

DIAGNOSIS. *Megaceras laevipenne* may be distinguished by the absence of a strongly impressed sutural stria and the slender form of parameres. Males of *M. laevipenne* could be confused with the males of *M. crassum*. Females of *M. laevipenne* can be recognized by the deep, strong transverse furrow on the pygidium.

DISTRIBUTION. *Megaceras laevipenne* occurs in Colombia and Guyana (Endrödi 1976). The specimens listed below from Brazilian Amazon states represent NEW COUNTRY RECORDS.

LOCALITY RECORDS. (Fig. 57) 17 specimens examined (7 males, 10 females). Specimens were seen from the following collections: INPA, CZPB, MZSP, MPEG.

AMAPÁ (1): Serra Lombard (Limão). AMAZONAS (16): Coari (Rio Urucu, RUC 39, RUC 27, LUC 09), Manaus (Am10 km 45); Maues (Javaretê), Parque Nacional do Jaú, São Gabriel da Cachoeira (Querari), Taracuá (Rio Uaupés).

TEMPORAL DISTRIBUTION. February (8), April (2), August (2), October (1), December (1).

BIOLOGY. Adults are nocturnal and are attracted to lights. *Megaceras laevipenne* has been collected from semi-humid ombrophilous forests and areas of seasonal whitewater inundation forest (várzea) at elevations of 30-115 meters.

***Megaceras philoctetes* (Olivier 1789)**
(Fig. 58-64)

Scarabaeus philoctetes Olivier 1789: 16
Megaceras teucer Burmeister 1847: 223 (synonym)
Megaceras lycaon Endrödi 1976: 32 (synonym)

DESCRIPTION. Length: 39.2-51.5 mm (males); 32.3-49.6 mm (females). Width: 19.6-26.9 mm (males); 12.1-28.2 mm (females). Color: Black.

Males. *Head*: Frons with long, recurved horn, posterior margin of horn with small, tooth-like swelling near apex, apex weakly acuminate. Eye canthus with rounded apex, anterior margin elevated forming a furrow, surface rugose. Clypeus with 2 strong teeth at apex (Fig. 59), surface finely punctate. Antenna with 10 segments, club subequal in length to segments 2-7. Mandibles with 2 subequal, triangular teeth, apex narrow. *Pronotum*: Majors (Fig. 60) with high, broad, bifurcated protuberance, apex with 2 small, subparallel, weakly curved downward horns. Surface slightly punctate, lateral margins with a band of spaced rugae, rugae connected to *areola apposita*. Minors (Fig. 61) with smaller protuberance, horns of the apex small, band of rugae reaching the apex. *Scutellum*: Smooth, triangular. *Elytra*: Smooth, sutural stria weakly impressed. *Pygidium*: Surface punctate, base with a band of reddish brown setae. Lateral angles finely rugose, surface convex in lateral view. *Legs*: Protibia tridentate. Apex of posterior tibia with a spur. First tarsomere of posterior tarsus triangular, apex extend into long spine. *Venter*: Prosternal process long, slightly convex, apex rounded to quadrangular with dense setae. *Parameres*: Pyriform, sides with a long, strongly projected tooth, apex dilated and setose (Fig. 62-63).

Females. As males except in the following respects: *Head*: Frons with conical tubercle, surface rugose. *Pronotum*: Surface smooth, without tubercles or tubercles very small behind anterior margin; sides with sparse punctures.

DIAGNOSIS. *Megaceras philoctetes* is characterized by its bidentate clypeus, frontal horn with apex acuminate, and pyriform parameres. Minor males could be confused with major males of *M. laevipenne* when the teeth of the clypeus are not well developed.

DISTRIBUTION. *Megaceras philoctetes* is known from Venezuela, Brazil, French Guiana,, Bolivia, Colombia and Peru. Dechambre (1998c) suggested the last two records should be confirmed because they lack specific data.

LOCALITY RECORDS. (Fig. 64) 42 specimens examined (19 males, 23 females). Specimens were seen from the following collections: INPA, CZPB, MZSP, IBSP, MPEG, UNSM.

AMAPÁ (2): Calçoene, Reginá, Serra do Navio. AMAZONAS (16): Benjamin Constant, Iranduba (Cacau Pireira), Manaus (BR 174 km 153), Presidente Figueredo, Rio Preto da Eva (Am 10 km 174), Taracua (Rio Uaupés), Tefé (São Mateus); Parque Nacional do Jaú (Rio Carabinani). PARÁ (21): Belém, Cachimbo, Cassidoré, Óbidos (Traira), Ourém Patauateva (Fazenda Gavião Real). RONDÔNIA (1): Vilhena.

TEMPORAL DISTRIBUTION. January (4), February (3), April (10), May (4), June (3), July (1), August (1), September (5), October (2), November (3), December (2).

NOMENCLATURAL REMARKS. Reiche (1859) established *Megaceras teucer* as a synonym of *Megaceras philoctetes*. This was confirmed by Dechambre (1975) and Endrödi (1985). In subsequent works Dechambre (1998c) compared the morphology of the parameres and determined *Megaceras lycaon* Endrödi, 1976, as new synonym of *M. philoctetes*.

BIOLOGY. Adults are nocturnal and are attracted to lights. In Brazilian Amazonia, *M. philoctetes* has been collected from ombrophilous forests, secondary forests, and floodplain areas at elevations ranging from the sea level to 600 meters.

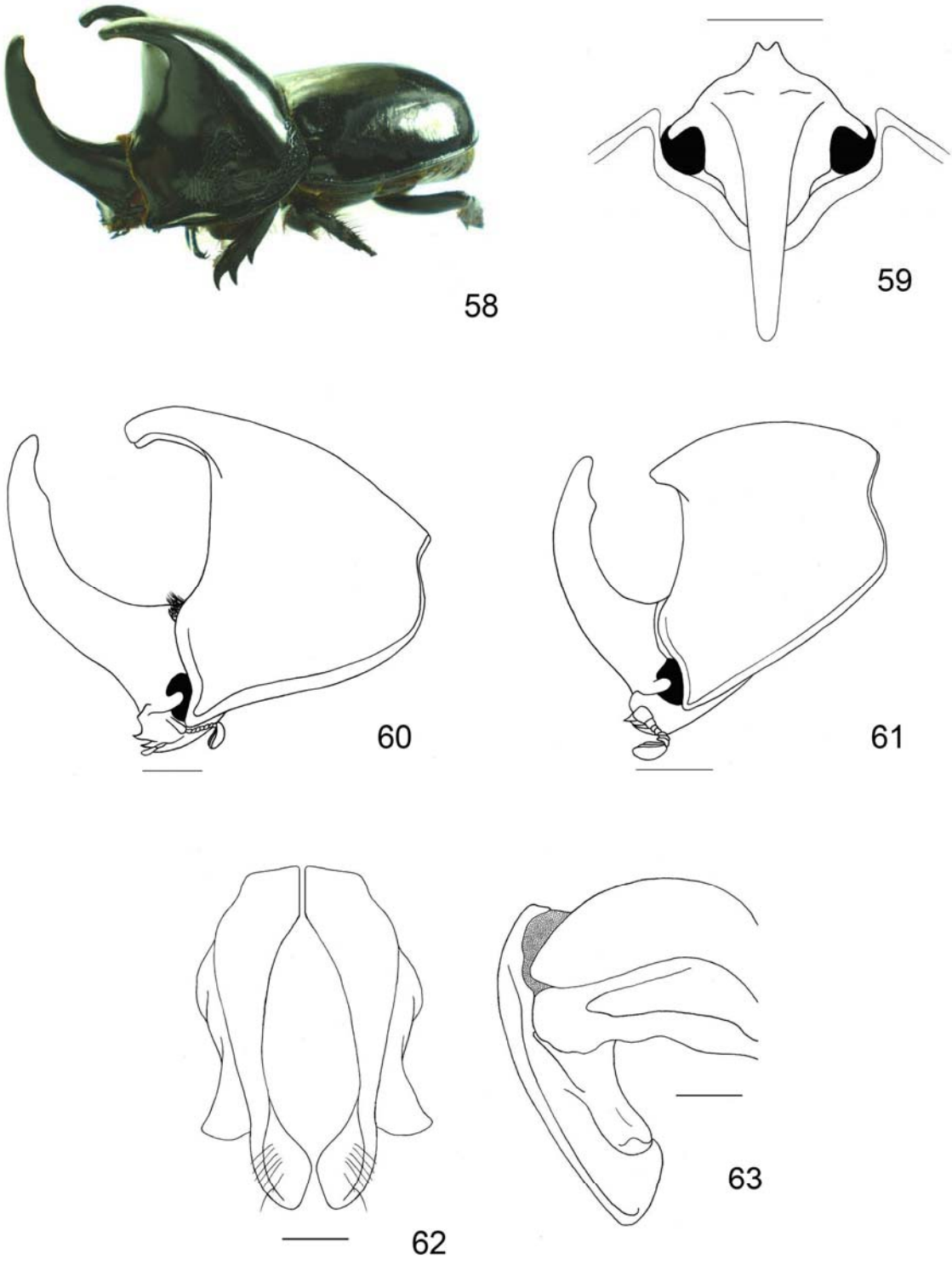

Figure 58-63. *Megaceras philoctetes*. **58)** Habitus. **59)** Male head (dorsal view). **60)** Male major. **61)** Male minor (scale line: 5 mm). **62)** Parameres frontal view. **63)** Parameres lateral view (scale line: 2 mm).

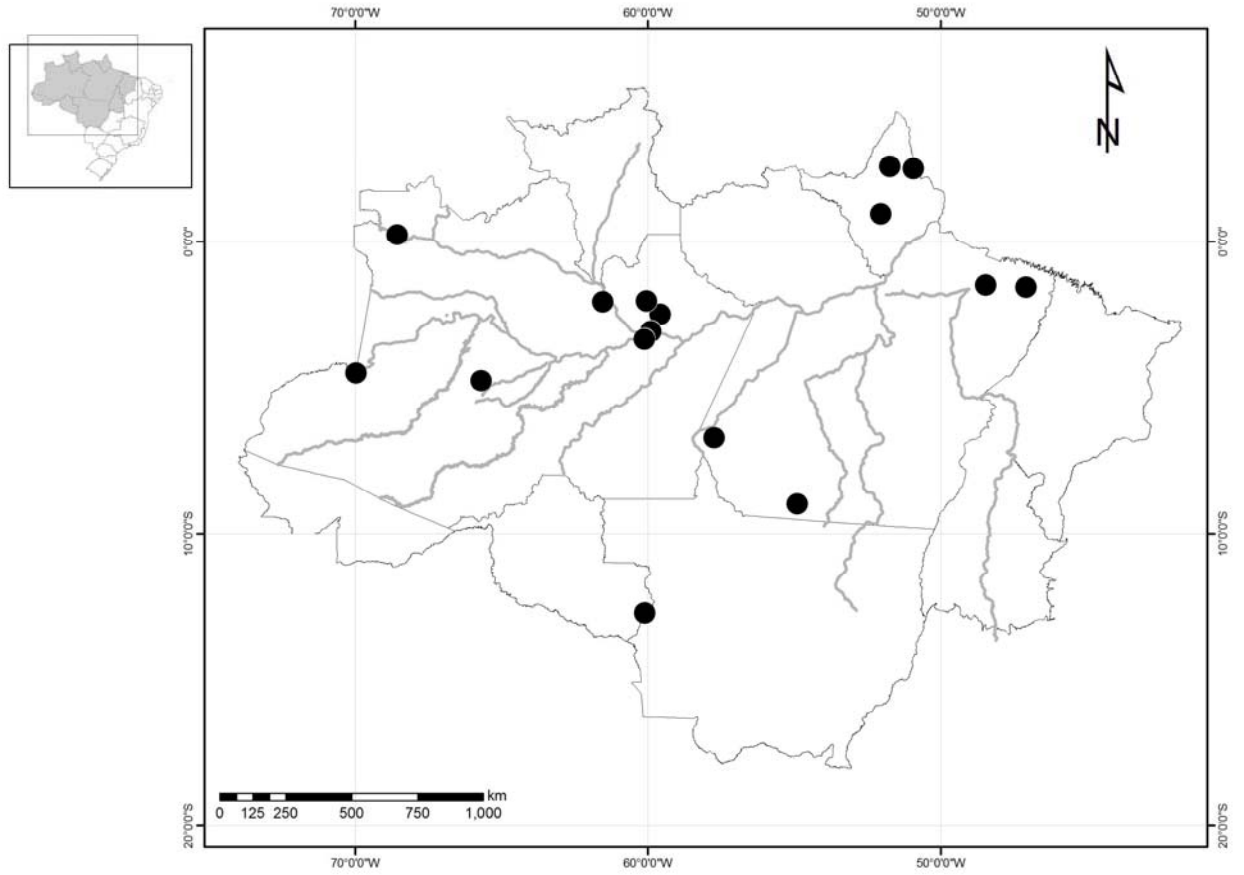

Figure 64. Distribution of *Megaceras philoctetes* in Brazilian Amazonia.

***Megaceras stuebeli* Kirsch 1885**
(Fig. 65-71)

Megaceras stuebeli Kirsch 1885: 223
Megaceras chorinaeus amazonicum Frings 1929: 21 (synonym, described as variation)

DESCRIPTION. Length: 42.5-62.3 mm (males); 39.3-52.2 mm (females). Width: 21.2-32.1 mm (males); 21.5-28.8 mm (females). Color: Black.

Males. *Head*: Frons with long, recurved horn, apex strongly bifurcated, posterior margin of horn with small, tooth-like swelling near apex. Eye canthus with rounded apex, margin weakly crenulate, surface finely punctate. Clypeus truncate, border weakly crenulate, apex slightly bilobed (Fig. 66), surface finely rugose. Antenna with 10 segments, club subequal in length to segments 2-7. Mandibles with 2 teeth, external tooth larger, with rounded apex, internal teeth with apex acuminate. *Pronotum*: Majors (Fig. 67) with large, high, bifurcated protuberance, apex with 2 divergent horns strongly curved downward, fovea broad. Lateral margins with a band of spaced rugae, rugae connected to *areola apposita*. Minors (Fig. 68) with smaller protuberance, apex with divergent tubercles projecting forward, bands of rugae in lateral margins reaching apex. *Scutellum*: Triangular, deep punctures distributed in central region. *Elytra*: Surface smooth, sutural stria impressed. *Pygidium*: Surface punctate. Base with band of long setae. Lateral angles rugose, in lateral view convex. *Legs*: Protibia tridentate. Apex of posterior tibia with a spur. First tarsomere of posterior tarsus triangular, apex extended into long spine *Venter*: Prosternal process long, convex, apex weakly acuminated to subquadrangular, with thick setae. *Parameres*: Oval, inner margins parallel, apex weakly dilated, rounded, setigerous (Fig. 69-70).

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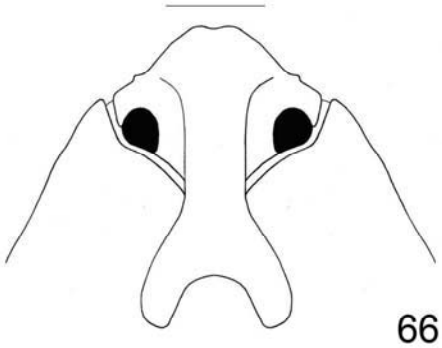

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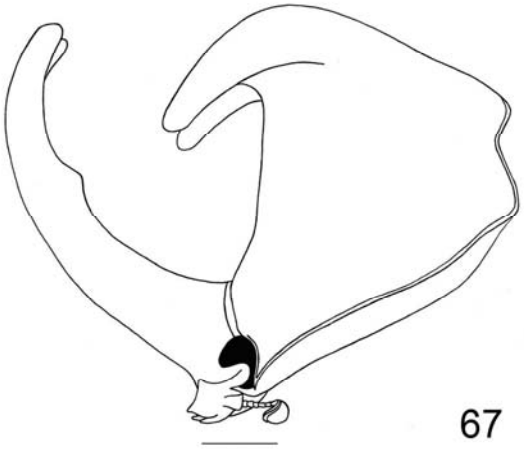

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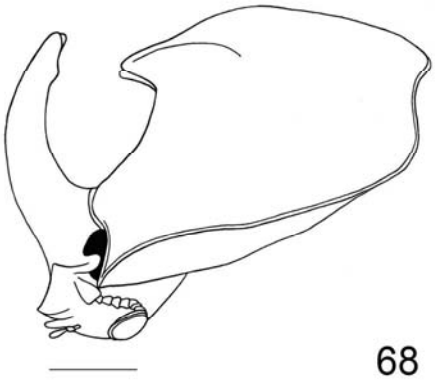

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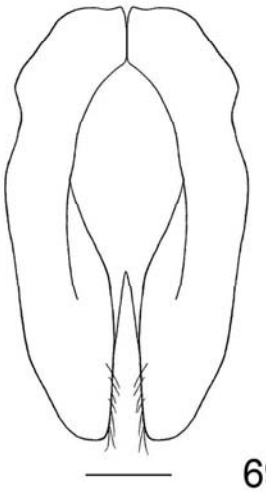

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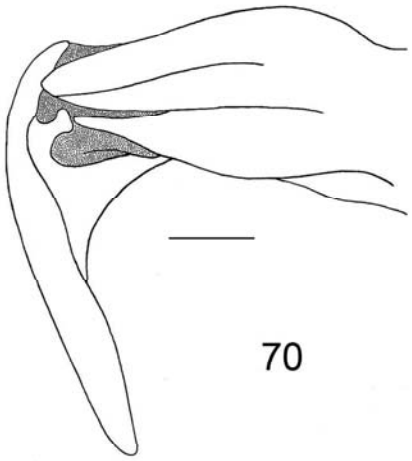

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Figure 65-70. *Megaceras stuebeli.* **65)** Habitus. **66)** Male head (dorsal view). **67)** Male major. **68)** Male minor (scale line: 5 mm). **69)** Parameres frontal view. **70)** Parameres lateral view (scale line: 1 mm).

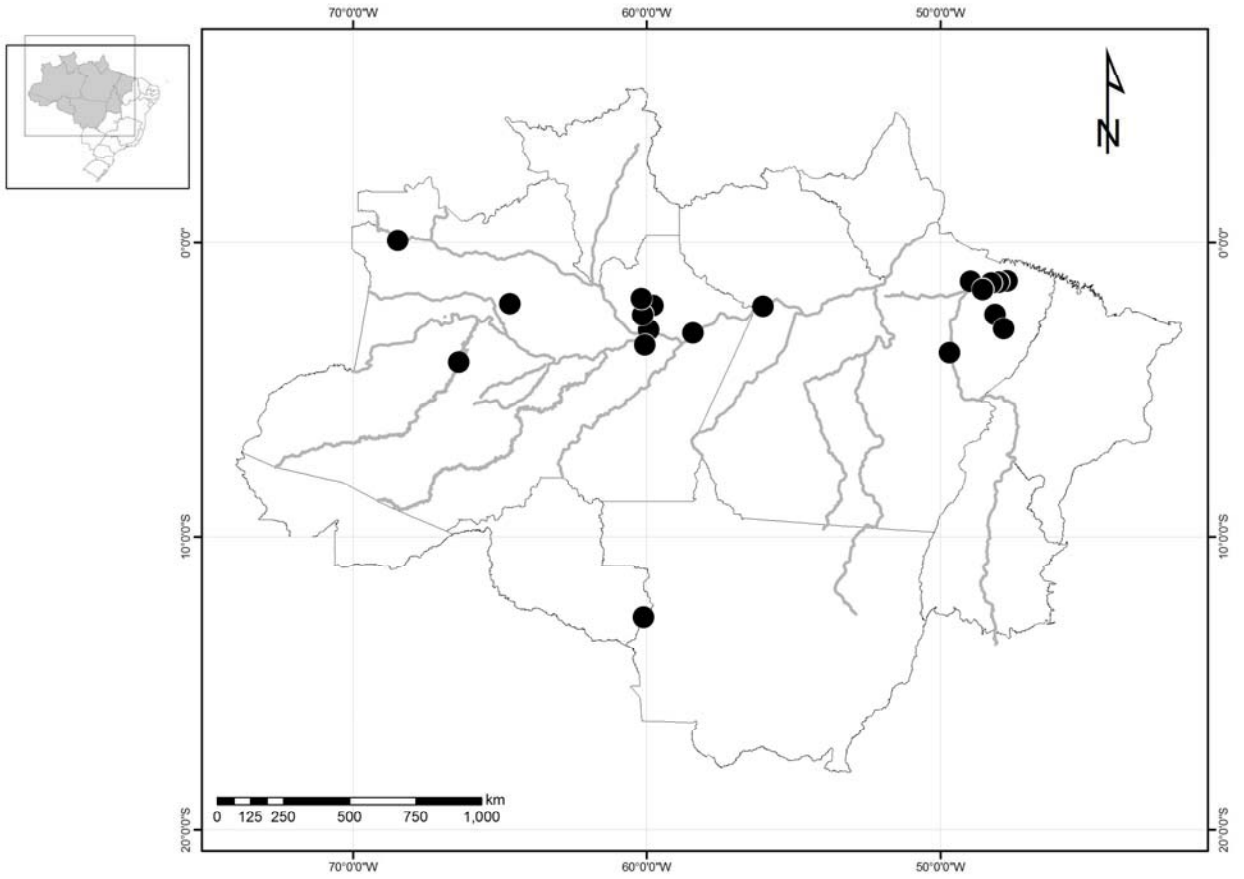

Figure 71. Distribution of *Megaceras stuebeli* in Brazilian Amazonia.

Females. As males except in the following respects: *Head*: Frons with small conical tubercle, surface rugose. *Pronotum*: Surface smooth, lateral margins with punctures, and with 2 small tubercles behind anterior margin. *Pygidium*: Surface finely punctate with sparse setae.

DIAGNOSIS. The large pronotal protuberance with two horns strongly curved downward and the bifurcate apex of frontal horn, are characters that will distinguish *M. stuebeli*. Minor males could be confused with minor males of *M. philoctetes*, and it is necessary to examine the parameres to differentiate these species when the teeth of the apex of the clypeus in *M. philoctetes* are not well developed.

DISTRIBUTION. *Megaceras stuebeli* is an endemic species of the Amazon region, with records only for the Brazilian Amazon. Endrödi (1976) recorded this species from Reseva Ducke, Maués River, and Manaus-Itacoatiara km 26 in Amazonas state. Lauchame (1992) recorded Pará state without specific locality data.

LOCALITY RECORDS. (Fig. 71) 130 specimens examined (62 males, 68 females). Specimens were seen from the following collections: INPA, CZPB, MZSP, MPEG, and UNSM.

AMAZONAS (106): Itacoatiara (Fazenda Aruana Am 10 km 215, Am 10 km 228), Manaus (Am 10 km 24, Am 10 km 45, Am 10 km 70, BR 174 km 45, BR 174 km 32, Cidade Nova, Distrito Industrial, Fazenda Dimona PDBFF, Reserva Ducke) Novo Airão (Rio Negro Paraná do Itauacu), Pedrinha, Presidente Figueredo (BR 174 Km 180, UHE Balbina, Rio Urubu), Taracuá (Rio Uaupés), Parque Nacional do Jaú (Rio Jaú), Rio Juruá. PARÁ (22): Açu (Tomé); Belém; Benevides; Castanhal (Estrada de Curuca km 8), Juriti, Ipixuna (Rio Capim), Marajó (Ponta Pedras), Marituba, Tucuruí. RONDÔNIA (2): Vilhena.

TEMPORAL DISTRIBUTION. January (12), February (25), March (5), April (8), May (7), June (15), July (12), August (10), September (6), October (7), November (9), December (5).

BIOLOGY. Adults are active at night and can be attracted to lights. In Brazilian Amazonia, adults have been collected from semi-humid ombrophilous forests, secondary forests, and floodplain areas from sea level to 600 meters.

Podischnus Burmeister 1847

Podischnus Burmeister 1847: 237
Mixigenus Thomson 1859: 7

Type species: *Scarabaeus agenor* Olivier, 1789.

Species of *Podischnus* may be recognized by the relatively long, subparallel body form, the four teeth on the protibia that project at nearly right angles, bidentate mandibles, and a broadly emarginate clypeus. Adults are nocturnal and attracted to lights. They probably feed on large-stemmed monocots, while the larvae feed on humus and detritus (Ratcliffe 2003). There are three species in the genus, occurring from South America to Mexico. Two species are known from Brazil and occur in the Brazilian Amazon.

Key to the species of adult *Podischnus* of Brazilian Amazonia

1. Males with punctures on sides of pronotum extending to base of horn. Female elytra with large, dense punctures ..... ***P. sexdentatus* (Taschenberg)**
— Males with punctures on sides of pronotum not extending to base of horn. Female elytra nearly smooth ..... ***P. agenor* (Olivier)**

Podischnus agenor (Olivier 1789)
(Fig. 72-76)

Podischnus agenor Olivier 1789: 223
Scarabaeus barbicornis Latreille 1812: 201 (synonym)
Podischnus propinquus Prell 1911: 202 (synonym)

DESCRIPTION. Length: 30.0-45.0 mm (males); 28.5-40.3 (females). Width: 15.0-22.0 mm (males); 13.0-19.0 mm (females). Color: Ligth to usually dark reddish brown.

Males. *Head*: Frons with long, recurved horn, surface smooth with few setae. Apex of horn acuminate and slightly expanded on posterior margin forming a tooth-like projection (Fig. 72). Eye canthus rounded, narrow, surface punctate, anterior margin weakly crenulate. Clypeus with apex broadly emarginate. Antenna with 10 segments, club subequal in length to segments 2-7. Mandibles broad, slightly bidentate at apex. *Pronotum*: Surface usually smooth, with some punctures; lateral margins rugopunctate, punctures large. Majors with short to moderate, broad horn, horn with apex broadly emarginate. Apical area of fovea with dense, short, fine, reddish brown setae. Base with marginal bead. Minors not seen but presumably with typical reduction. *Elytra*: Sutural stria strongly impressed, median half with small, moderately dense punctures. Lateral margins with incomplete rows of moderate to large, ocellate punctures; punctures decreasing in size posteriorly. *Pygidium*: Surface finely rugulose, with small, moderately dense punctures. In lateral view, surface convex, flat in apical third. *Legs*: Protibia strongly quadridentate, teeth nearly perpendicular to shaft of tibia (Fig. 73), distance between 2 apical teeth less than distance between other teeth. Apex of posterior tibia with 2 teeth. Metatarsus with apex of first tarsomere long, spine-like. *Venter*: Prosternal process short, apex rounded, anterior surface flat. *Parameres*: Long, slender, base acuminated, apex rounded (Fig. 74-75).

Females. As males except in the following respects: *Head*: Frons and clypeus with surface strongly rugopunctate. Frons with a tubercle between eyes. *Pronotum*: Surface rugose in anterior half and at

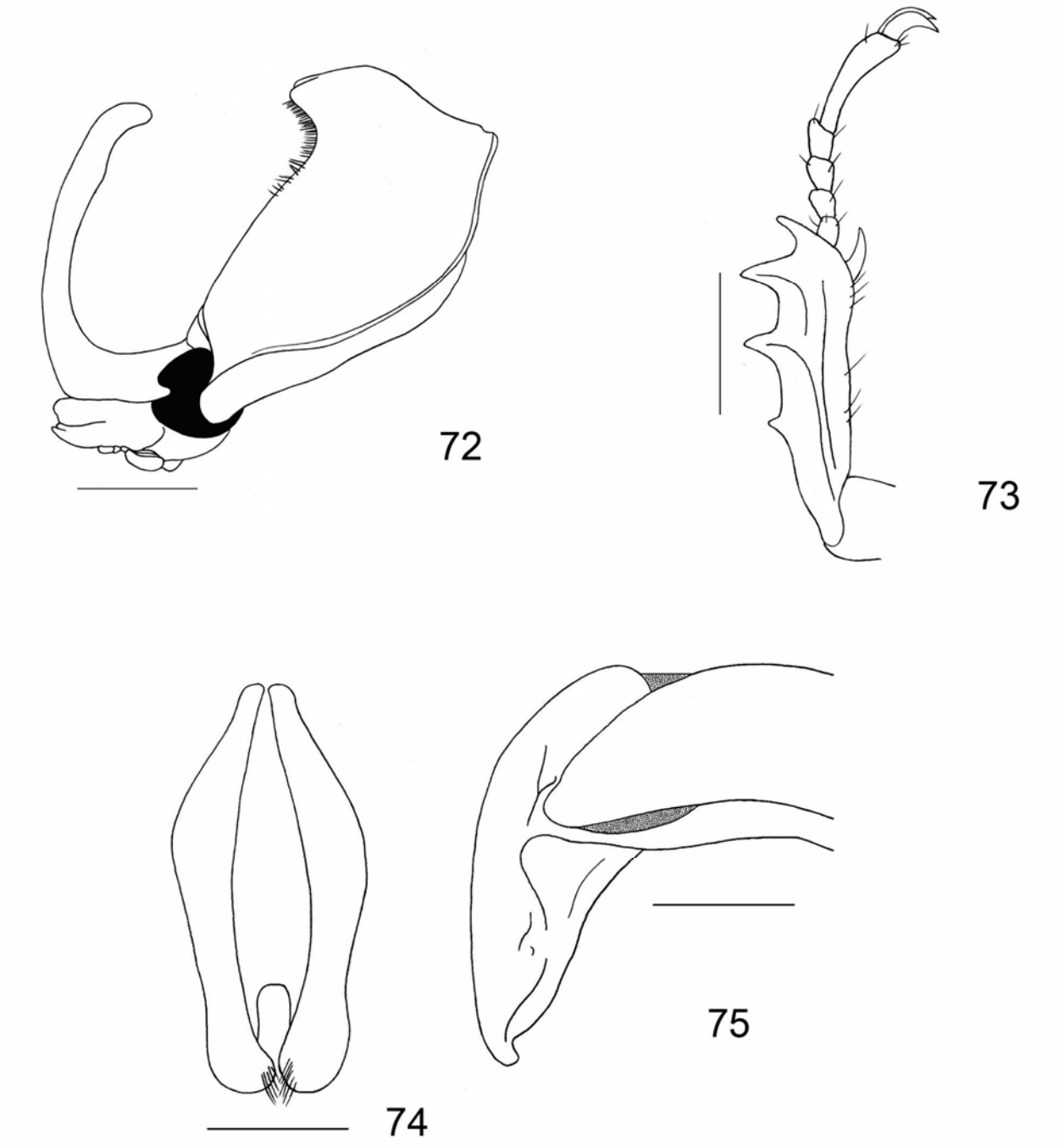

Figure 72-75. *Podischnus agenor*. **72)** Male head and pronotum. **73)** Protibia (scale line: 5 mm). **74)** Parameres frontal view. **75)** Parameres lateral view (scale line: 2 mm).

sides, median half with some punctures. Tubercles or prominences lacking. *Pygidium*: Surface with small, moderately dense setae. In lateral view, dorsal half weakly convex, apical half weakly concave.

DIAGNOSIS. *Podischnus agenor* is easy recognized by the four teeth of the protibia projecting at nearly right angles from the tibia. This is the only Neotropical genus of Oryctini that has this configuration of protibial teeth. The long, subparallel body form is another character that helps to identify *P. agenor*.

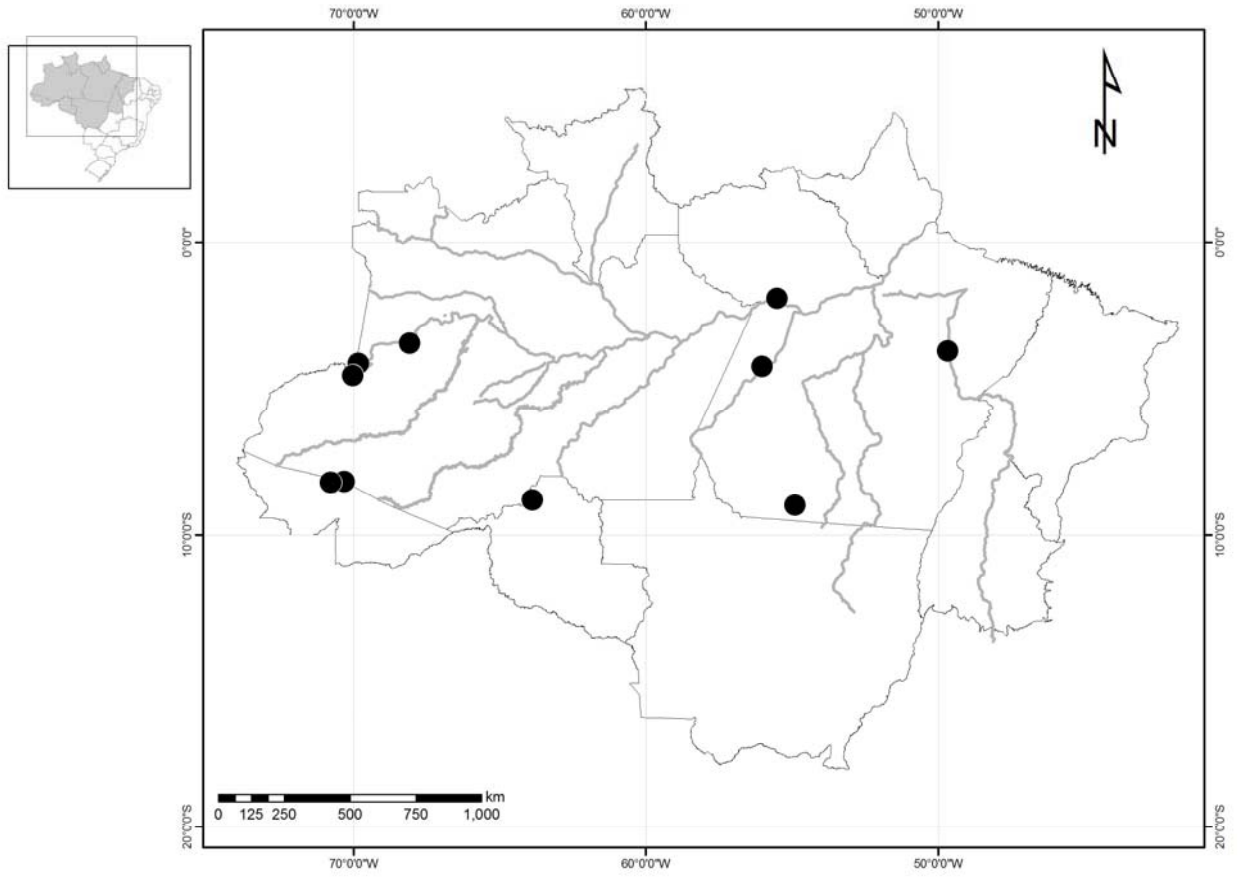

Figure 76. Distribution of *Podischnus agenor* in Brazilian Amazonia.

DISTRIBUTION. *Podischnus agenor* is widely distributed, occurring from southern Mexico, Central America, Colombia, Perú, Ecuador to northern Brazil.

LOCALITY RECORDS. (Fig. 76) 185 specimens examined (129 males, 56 females). Specimens were seen from the following collections: MZSP, MPEG, IBSP.

ACRE (2): Feijó, Tarauacá. AMAZONAS (176): Benjamin Constant (Rio Javari), São Paulo de Olivença (Rio Solimões), Tabatinga. PARA (6): Cachimbo, Itaituba (Santaremsinho), Óbidos, Tucurui (Rio Tocantins). RONDÔNIA (1): Porto Velho.

TEMPORAL DISTRIBUTION. January (1), March (1), April (2), May (1), July (7), September (142), October (4), November (26), December (1).

BIOLOGY. Usually the adults of *P. agenor* are abundant before the beginning of the rainy season and are more active at night (Ratcliffe 2003). This species causes great damage to sugarcane. The adults of both sexes, but especially the males, perforate the stems and excavate burrows in the median and superior areas. They use the mandibles to burrow into the plant tissues, and the pronotal and head horns help to penetrate the stem (Eberhard 1979). The life cycle can last one year. The larva grows in the soil where it feeds on organic matter (Eberhard 1979; Mendonça 1996). The pupa is also found in the soil. The larva develops for 4-8 months, and the pupa 2-3 months (CENGICAÑA 2004).

The males emitted a pheromone or pungent odor, seemingly to attract females. When the female is attracted, she is often allowed to enter the burrow to feed. Combat between males occurs when another male is attracted (Eberhard 1979). *Podischnus agenor* has been noted as a pest of *Bambusa vulgaris*

Schrad in Guatemala (Francis 1993), *Bambusa guadua* Humboldt and Bonpland, and *Guadua angustifolia* Kunth in Colombia (Rojas 1991). It is a pest of sugarcane in Venezuela (Rincones et al. 1991). The larvae of *P. agenor* are parasitized by the wasp *Pelecinus polyturator* Drury (Hymenoptera: Pelecinidae) (Arias-Pena 2003).

In Brazilian Amazonia, *P. agenor* has been collected from semi-humid ombrophilous forests, degraded vegetation areas, and floodplain areas at elevations ranging from 10-400 meters.

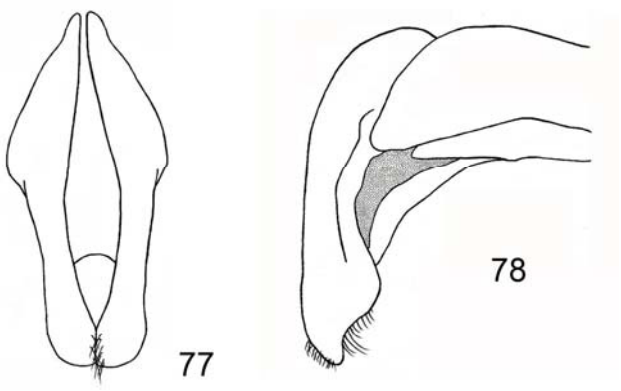

Figure 77-78. *Podischnus sexdentatus*. **77)** Parameres frontal view. **78)** Parameres lateral view.

***Podischnus sexdentatus* (Taschenberg 1870)**
(Fig. 77-79)

Heterogomphus sexdentatus Taschenberg 1870: 186
Podischnus beckeri Sternberg 1907: 347 (synonym)

DESCRIPTION. Length: 35.0-47.0 mm (males); 40.5-46.3 mm (females). Width: 15.5-20.0 mm (males); 14.0-19.7 mm (females). Color: Light to usually dark reddish brown.

Males. *Head*: Frons in majors coarsely rugopunctate except for smooth area along midline behind base of horn. Minors with frons longitudinally rugopunctate either side of median smooth area. Majors with long, recurved horn; horn acuminate at apex and with distinct swelling on posterior edge below apex. Male minors with small, recurved horn. Clypeus with apex broadly emarginate. Antenna with 10 segments, club subequal in length to segments 2-7. Mandibles broad, bidentate at apex. *Pronotum*: Surface in majors with large, scallop-shaped punctures on sides that extend to base of horn. Central third with small, sparse punctures and impressed groove extending from base of horn to anterior margin; groove with dense, moderately large punctures. Surface in front of posterior angles and base with small, sparse punctures. Anterior 2/3 weakly concave, posterior third with short, broad horn; horn projecting forward, apex broadly emarginate, venter concave and with dense, short, reddish brown setae. Base with marginal bead. Minors similar but with horn reduced to prominent tubercle, and punctures surrounding discal convexity denser, many confluent. *Elytra*: Majors with surface finely shagreened, with strongly impressed sutural stria, and with 3-5 short to moderate rows of large, ocellate punctures behind humerus on sides, punctures decreasing in size posteriorly. Minors similar. *Pygidium*: Surface transversely rugulose. In lateral view, surface convex in basal third, nearly flat elsewhere. Minors in basal third often with sparse, small punctures replacing rugosity. *Legs*: Protibia strongly quadridentate, teeth nearly perpendicular to shaft of tibia, distance between 2 apical teeth less than distance between other teeth. Metatibia with 3 (usually) or 4 strong teeth at apex. Metatarsus with apex of first tarsomere long, spine-like. *Venter*: Prosternal process subtriangular, with rounded apex, anterior surface flat. *Parameres*: Similar to those of *P. agenor* (Fig. 77-78).

Females. As males except in following respects: *Head*: Frons and clypeus coarsely rugose, frons with strong tubercle between eyes. *Pronotum*: Surface coarsely rugose in anterior fourth and at sides; elsewhere with small, sparse punctures. Armature absent. *Elytra*: Surface with large, dense punctures; punctures small and sparse in first interval, along lateral margins, and near apices. *Pygidium*: Surface with small, sparse to moderate punctures. In lateral view, basal third weakly convex, apical two-thirds weakly concave.

DIAGNOSIS. The adults of *P. sexdentatus* may be confused with *P. agenor*. In males, the punctures on the sides of the pronotum in *P. sexdentatus* extend to the base of the horn, while in *P. agenor* the pronotum is smoother and the punctures on the sides of the pronotum do not extend to the base of the horn. The prosternal process in *P. sexdentatus* is longer than in *P. agenor*.

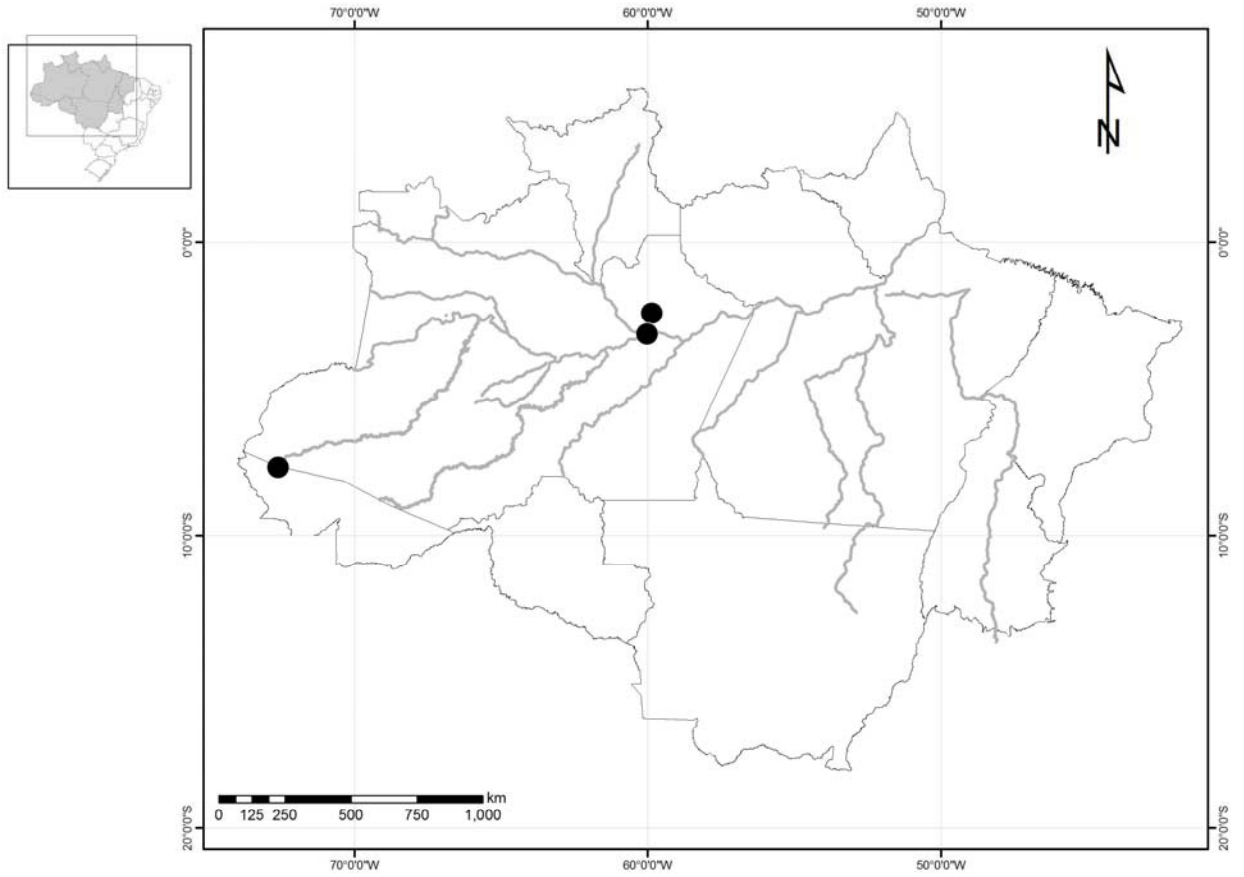

Figure 79. Distribution of *Podischnus sexdentatus* in Brazilian Amazonia.

DISTRIBUTION. *Podischnus sexdentatus* is known from Colombia and the Amazon region of Perú and Brazil (Endrödi 1976, 1985).

LOCALITY RECORDS. (Fig. 79) 7 specimens examined (3 males, 4 females). Specimens were seen from the following collections: INPA, UNSM.

ACRE (5): Cruzeiro do Sul. AMAZONAS (2): Manaus (AM 010 km 45, AM 60 km 23 Fazenda Esteio).

TEMPORAL DISTRIBUTION. February (1), May (1), September (5)

BIOLOGY. Nothing is known of the life history of *P. sexdentatus*. In Brazilian Amazonia, this species has been collected from areas of secondary vegetation and floodplain areas.

Strategus Kirby 1828

Strategus Kirby 1828: 349
Strategodes Casey 1915: 245 (synonym, described as subgenus)
Anastrategus Casey 1915: 231 (synonym)
Strategopsis Chapin 1932: 302 (synonym, described as subgenus)

Type species: *Scarabaeus aloeus* Linnaeus, 1758.

Species of *Strategus* may be distinguished by mandibles exposed with apex bidentate and with a prominent basal lobe; pronotum foveate and at least tuberculate subapicaly, protibia quadridentate, and apex of metatibia with three teeth. Adults are nocturnal and attracted to lights. The larvae live in rotting tree trunks and possibly in rich organic debris in the soil. Adults have been observed feeding on the roots of several species of palms (Ratcliffe 2003). The genus contains 37 species (Morón and Nogueira 2008) distributed from southern United States, through Central America, to southern Argentina, including the Greater and Lesser Antilles. There is one possible fossil species. Five species are registered in Brazil, of which four occurs in Brazilian Amazonia.

Key to the species of adult *Strategus* of Brazilian Amazonia

1. Clypeus with apex emarginate, slightly reflexed. First segment of posterior tarsus usually triangular, apex slightly attenuated into acute angle (Fig. 86) **2**
— Clypeus with narrow, slightly acuminate apex. First segment of posterior tarsus elongated and quadrangular (Fig. 98) **3**

2(1). Sides of elytra usually smooth, without punctures or with small punctures behind humerus (Fig. 84) ..... ***S. aloeus* (Linnaeus)**
— Sides of elytra with 1-3 rows of small to large, ocellate punctures behind humerus (Fig. 103) .... ***S. validus* (Fabricius)**

3(1). Punctures on disc of pronotum and elytra small. Pygidium usually with a small, medioapical band of setigerous punctures. Amazon River south to Argentina .... ***S. surinamensis hirtus* Sternberg**
— Punctures on disc of pronotum and elytra minute to very small. Pygidium without a medioapical band of setigerous punctures. Amazon River north to Venezuela .... ***S. surinamensis surinamensis* Burmeister**

***Strategus aloeus* (Linnaeus 1758)**
(Fig. 80-89)

Scarabaeus aloeus Linnaeus 1758: 345
Geotrupes semiramis Fabricius 1801:12 (synonym)
Scarabaeus aesalus Laporte 1840: 112 (synonym)
Srategus julianus Burmeister 1847: 133 (synonym)
Strategus piosomus Kolbe 1906: 24 (synonym)
Strategus arizonicus Schaeffer 1915: 51 (synonym)
Strategus roosevelti Casey 1915: 241 (synonym)
Strategus frontalis Casey 1915: 243 (synonym)
Strategus tarsalis Casey 1915: 243 (synonym)
Strategus gaillardi Casey 1915: 244 (synonym)

DESCRIPTION. Length: 41.6-53.4 mm (males); 41.2-48.7 mm (females). Width: 21.1-27.6 mm (males); 19.7-24.5 mm (females). Color: Reddish brown to black.

Males. *Head*: Frons densely punctate to rugose, with 2 low to moderate conical tubercles. Eye canthus with apex strongly rounded, surface punctate. Clypeus with surface punctate and rugose, apex subtruncate, broadly emarginate, reflexed, usually with small notch at center (Fig. 81). Antenna with 10 segments, club subequal in length to segments 2-7. Mandibles with 3 lobes; basal lobe small, rounded; middle lobe large, subtriangular, with apex broadly rounded; apical lobe small, with apex rounded to subtriangular. *Pronotum*: Surface of posterior half punctate, punctures small; surface of sides densely punctate, punctures small to large. Fovea deep, surface strongly punctate, divided longitudinally down middle by a broad, low, rounded carina extending posteriorly from base of anterior horn. Majors (Fig. 82) with anterior horn moderate in length, stout, curving forward and upward, apex subtruncate to emargin-

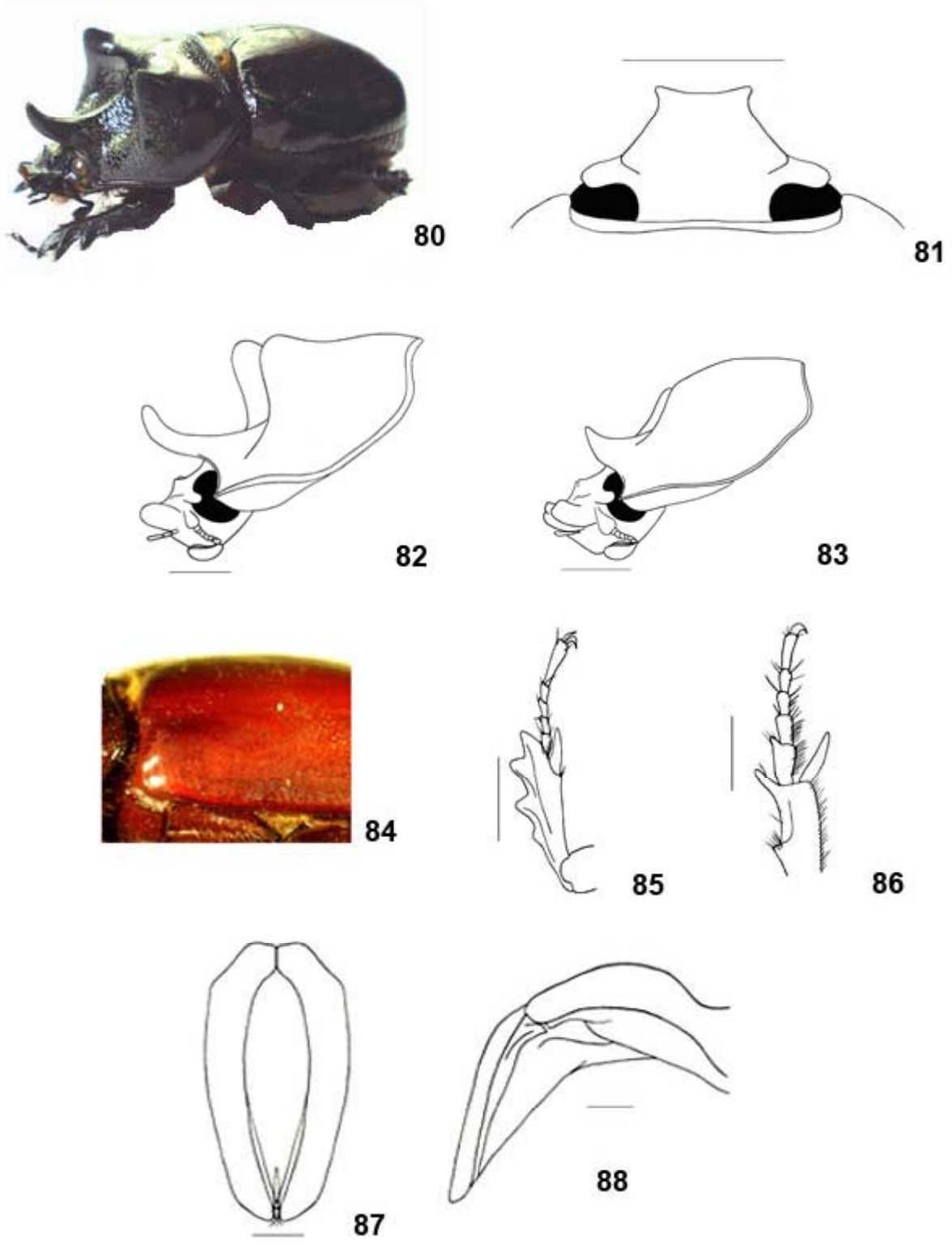

Figure 80-88. *Strategus aloeus*. **80)** Habitus. **81)** Male head (dorsal view). **82)** Male major. **83)** Male minor (scale line: 5 mm). **84)** Elytra (lateral view). **85)** Male major. **86)** Male minor (scale line: 5 mm). **87)** Parameres frontal view. **88)** Parameres lateral view (scale line: 1 mm).

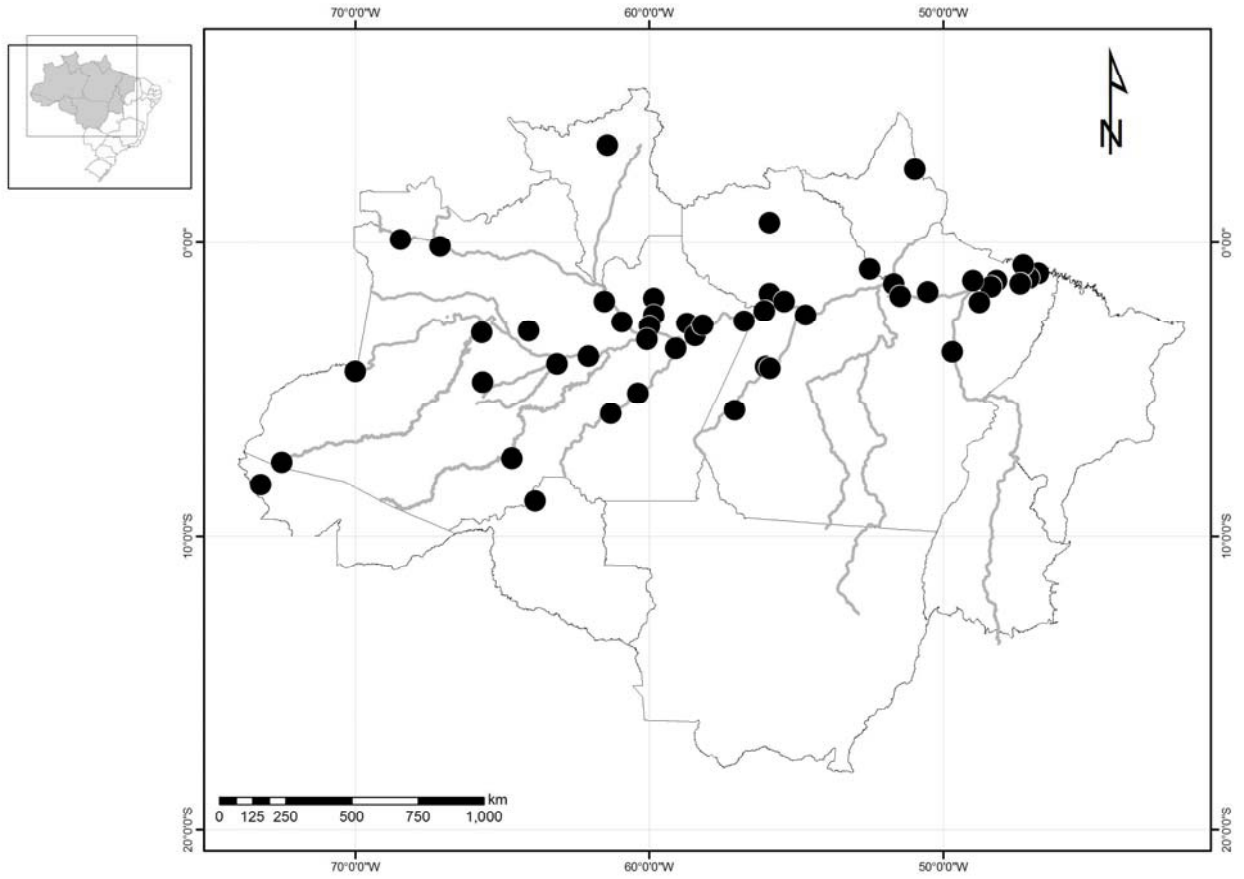

Figure 89. Distribution of *Strategus aloeus* in Brazilian Amazonia.

ate. Posterior horns short to moderately long, strongly laterally compressed, apex rounded and obliquely truncate with 1-3 lobes. Horns subparallel in lateral view. Minors (Fig. 83) with anterior horn short, apex truncate; posterior horns reduced to short, rounded, laterally compressed projections. Base with a wide to very wide rugose band, band reduced at middle almost to basal bead. *Elytra*: Surface shiny. Sutural stria strongly impressed, crenulate. Surface with small punctures. Incomplete striae on lateral half of disc. Sides with small to moderate punctures, surface wrinkled to smooth behind humerus (Fig. 84). *Pygidium*: Surface sparsely micropunctate; with band of long setae at posterior margin. Convex in lateral view. *Legs*: Protibia quadridentate, teeth projecting obliquely (Fig. 85). Apex of posterior tibia with 3 teeth, median tooth smaller. Metatarsus with apex of first tarsomere slightly attenuated into acute angle (Fig 86). *Venter*: Prosternal process long, apex rounded, densely setose. *Parameres*: Oval, stout, base broad, strongly contracted toward apex (Fig. 87-88).

Females. As males except in the following respects: *Head*: Frons punctate, punctures small. Clypeus with apex narrow to subtruncate or rounded. Mandibles smaller, lobes with rounded apex. *Pronotum*: Surface of anterior half rugose, sides punctate to rugose. Fovea small, moderately deep. Conical tubercles, moderate to large, apex usually rounded. *Elytra*: Surface on sides occasionally with ocellate punctures. *Pygidium*: Surface moderately punctate, punctures small. Band of setae in posterior margin smaller, apex with 2 bands of small setae. In lateral view, basal half convex, apical half concave.

DIAGNOSIS. *Strategus aloeus* is the most abundant and morphologically variable species in the genus. The males could be confused with other *Strategus* species where external characters are used only in the identification. However, they can be separated from all other species by the shape of the parameres. The characters listed in the key will serve to separate *S. aloeus* from other species that occur in Brazilian Amazonia. Ratcliffe (2003) observed that *S. aloeus* populations in South America are usually larger in

size, darker, with a deep clypeal excision and with stouter genitalia in the males, while the populations in North America and Central America are usually smaller and lighter in color.

DISTRIBUTION. *Strategus aloeus* is the most widely distributed species in the genus, occurring from the southern United States through Central America to central Brazil and Bolivia (Ratcliffe 1976). This species is found commonly throughout the Brazilian Amazon.

LOCALITY RECORDS. (Fig. 89) 413 specimens examined (142 males, 268 females). Specimens were seen from the following collections: INPA, CZPB, MZSP, MPEG.

ACRE (1): Rio Branco. AMAPÁ (4): Calçoene. AMAZONAS (294): Autazes, Benjamin Constant (Rio Javarí), Canutama (Nova Vista, Igarapé Gyssua), Coari, Codajas, Itacoatiara (Ponte Mamoud Amed Am 10, Fazenda Aruanã Am 10 km 215, Fazenda Saracá), Lábrea (Ramal Aperal km 9 Sitio São Raimundo), Manaus (BR 174 km 153, Coroado, INPA, Cidade Nova, Fazenda Esteio, Reserva Ducke), Manicoré, Maraã (lago Amaná, Rio Japurá), Médio Purús, Novo Airão (Rio Jaú, Ramal do Olimpo), Novo Aripuanã, Parintins, Parque Nacional do Jaú, Presidente Figueredo (UHE Balbina, Rio Urubu), São Gabriel da Cachoeira, Silves, Taracuá (Rio Uaupés), Tefé, Uarini. PARÁ (100): Ananindeua (Curuçamba), Belém, Bragança (Santa Maria), Breves (Corcovado), Capitão Poço, Gurupá, Itaituba (Santaremsinho, Rio Tapajos), Juriti, Marajó (Ponta Pedras), Melgaço (Estação Científica Ferreira Penna), Mocambo, Moju (Fazenda Latomiz), Monte Dourado, Óbidos, Oriximiná, Peixe Boi, São Francisco, São João de Pirabas (Japerica, ilha Concepção), São José, Santarém, Tucurui (Rio Tocantins). RONDÔNIA (5): Porto Velho, Surumú. RORAIMA (3): Amajari (Ilha Maracá, Rio Uraricoera).

TEMPORAL DISTRIBUTION. January (7), February (25), March (28), April (18), May (66), June (47), July (33), August (45), September (50), October (21), November (53), December (5).

BIOLOGY. In general the biology of *S. aloeus* is well known. Information related to the natural history of this species was presented by Ratcliffe (1976, 2003) and Ratcliffe and Cave (2006). The larvae and pupae were described by Dugès (1886) and Ritcher (1966). Hurpin and Mariau (1966), conducted experiments to observe the life cycle. Deloya (1988) found adults in nests of *Atta mexicana* (Smith). Bodkin (1919) remarked on natural enemies.

In Brazil, *S. aloeus* has been found feeding of the roots of the "carnauba", *Copernicia cerifera* Martius (Arecaceae) (Gonçalves 1946; Bondar 1941), sugarcane *Saccharum officinarum* L. (Silva et al. 1968), and the roots and lower part of the stems of coconut palms (Costa Lima 1953; Lever 1969, Bondar 1939, 1940a,b; Carvalho 1940). The larvae of *S. aloeus* are important as intermediate hosts for *Macracanthorhynchus hirudinaceus* (Pallas) (Archiaacanthocephala: Oligacanthorhynchidae) (Costa Lima 1953).

Sefer (1961) classified *S. aloeus* as one of the species that attack coconut trees (roots and stems) in the Amazon region. In Amapá state, *S. aloeus* is known as "broca-do-bulbo" or bulb drill, and it is an important pest of *Bactris gasipaes* Kunth ("pupunheira") (Gazel Filho 2000). In Roraima, *S. aloeus* is known as "broca-da-raiz" or root drill; adults attack the young plants of the coconut palm, *Copernicia cerifera*, producing high mortality in large infestations (Pereira et al. 2004).

Adults are nocturnal and are attracted to lights In Brazilian Amazonia adults have been collected from agricultural areas, semi-humid ombrophilous forests, savannah fields, and areas of seasonal whitewater inundation forest (várzea) at elevations ranging from sea level to 250 meters.

***Strategus surinamensis hirtus* Sternberg 1910**
(Fig. 90-94)

Strategus hirtus Sternberg 1910: 100
Strategus kolbeanus Prell 1934: 164 (synonym)

DESCRIPTION. Length: 18.1-40.3 mm (males); 33.2-37.8 mm (females). Width: 13.0-19.7 mm (males); 16.6-18.5 mm (females). Color: Castaneous to piceous.

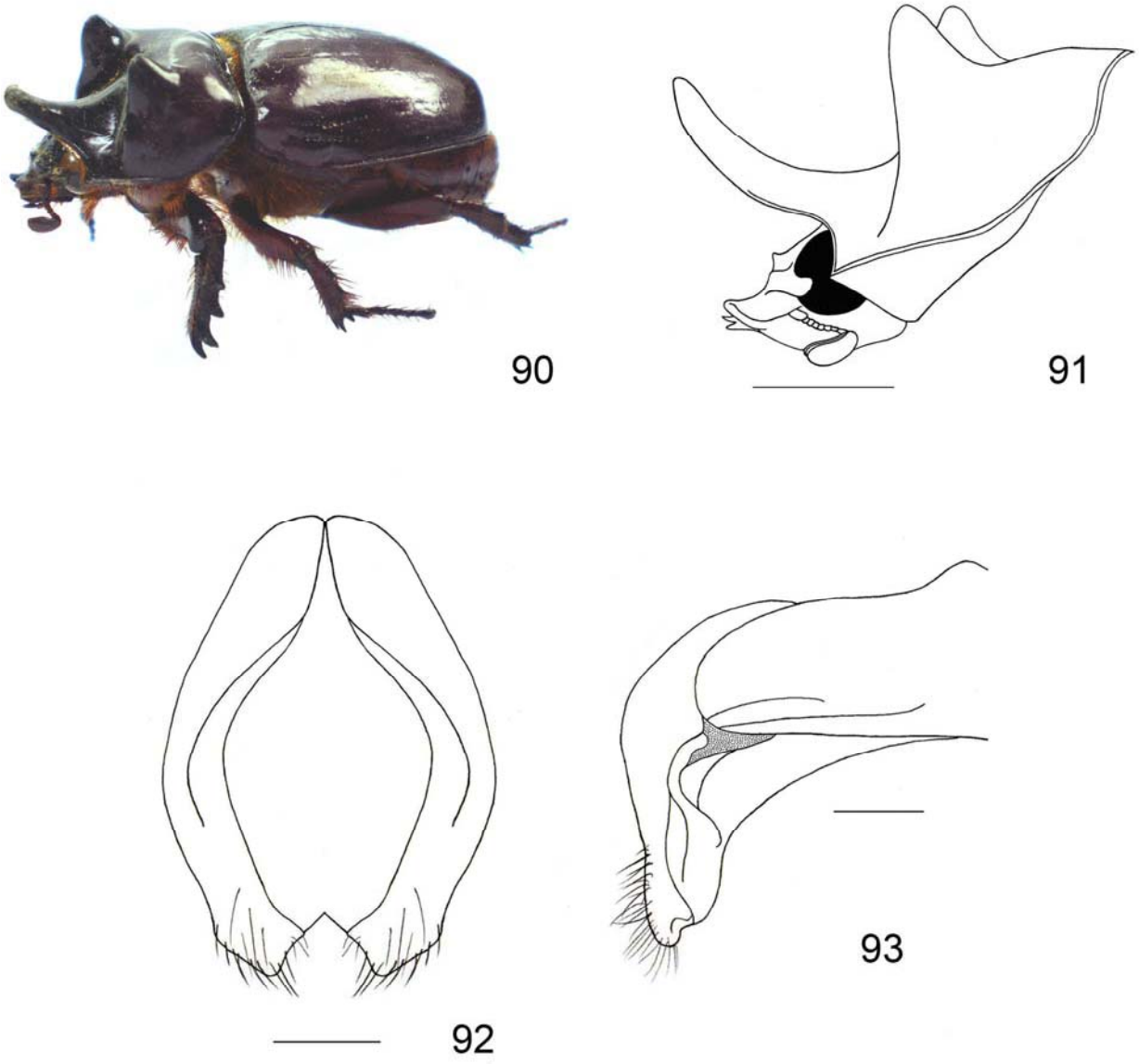

Figure 90-93. *Strategus surinamensis hirtus*. **90)** Habitus. **91)** Male head and pronotum (scale line: 5 mm). **92)** Parameres frontal view. **93)** Parameres lateral view (scale line: 1 mm).

Males. *Head*: Frons with surface strongly punctate, with 2 strong, conical, transverse and widely separated tubercles. Eye canthus with surface punctate to rugose, apex rounded. Clypeus with narrow, weakly acuminate apex; surface rugose, slightly punctate. Antenna with 10 segments, club subequal in length to segments 2-7. Mandibles with 3 lobes; basal lobe small, apex rounded; middle lobe large, subtriangular, apex rounded; apical lobe small, triangular, apex rounded. *Pronotum*: Base with rugopunctate band, band reduced to basal bead at middle. Surface finely punctate, punctures small. Sides with punctures larger in size or with a rugose band at lateral margin. Fovea deep, usually with a longitudinal carina extending posteriorly from base of anterior horn. Majors (Fig. 91) with anterior horn long, slender, curving forward, apex rounded. Posterior horns long, stout, laterally compressed, apex rounded. Minors not seen, presumably with a typical reduction of anterior and posterior horns. *Elytra*: Sutural stria strongly impressed, distinctly crenulate. Surface granulate, sparsely punctate, punctures small; occasionally with 1-3 feebly impressed striae. Sides with 2-3 short rows of moderately deep, ocellate punctures behind humerus. *Pygidium*: Surface finely granulate, moderately punctate, punctures small.

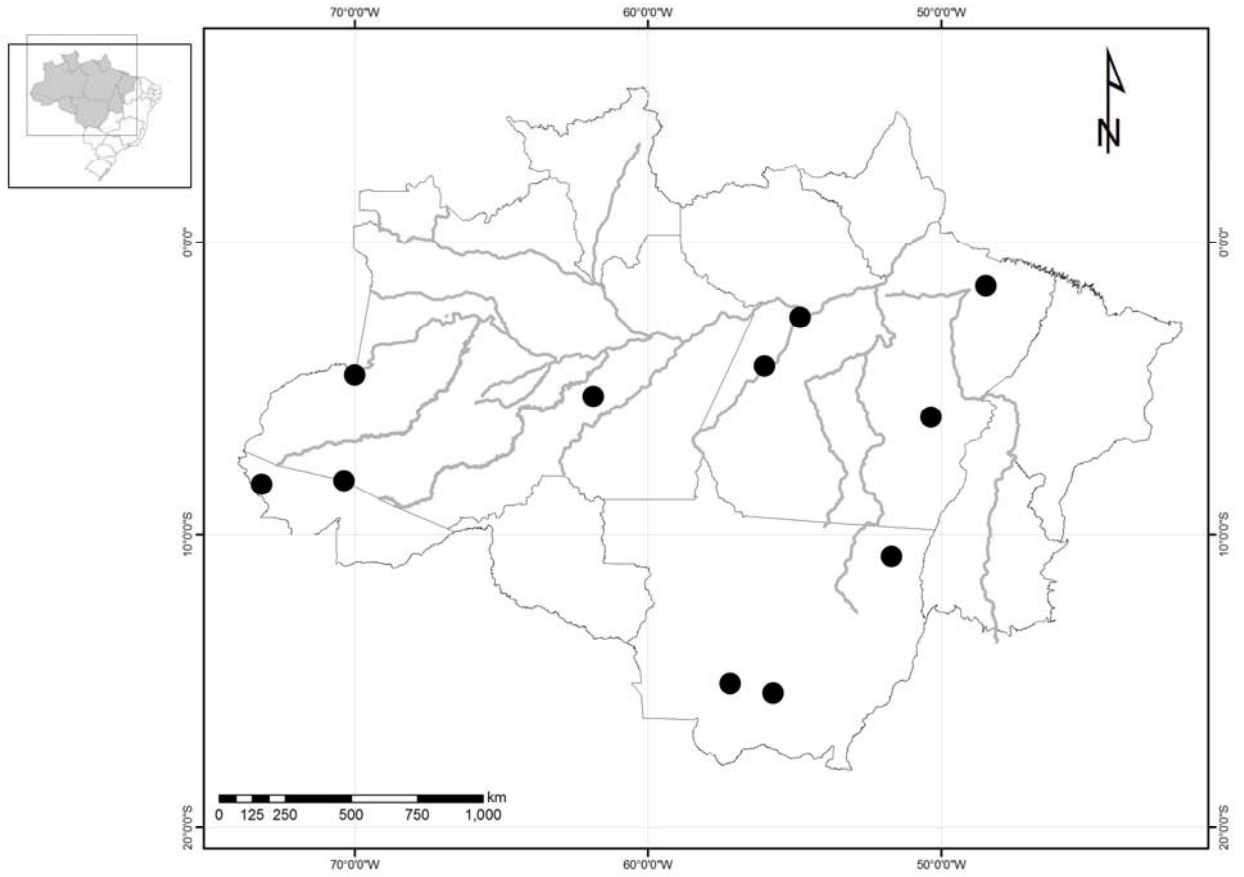

Figure 94. Distribution of *Strategus surinamensis hirtus* in Brazilian Amazonia.

Occasionally with a band of setigerous punctures in apical half. Lateral angles rugose. *Legs*: Protibia quadridentate. Apex of posterior tibia with 2-3 teeth, median tooth reduced, with rounded apex. First tarsomere of posterior tarsus elongated, quadrangular. *Venter*: Prosternal process densely setose, long, apex rounded. *Parameres*: Oval, slightly variable in degree of curvature, apex setose (Fig. 92-93).

Females. As males except in the following respects: *Head:* Frons rugose. Mandibles similar in size, middle lobe smaller. *Pronotum*: Sides in basal half with lateral margin rugose to punctate. Anterior half rugose. Fovea reduced, moderately deep, surface strongly rugose to punctate. Tubercles conical, transverse. *Pygidium*: Surface completely rugose to punctate, densely setose, setae long. Apex with 2 small bands of setae. In lateral view, basal half convex, apical half moderately concave.

DIAGNOSIS. *Strategus surinamensis hirtus* can be separated from *S. surinamensis surinamensis* by the granulate to moderately punctate surface of the pygidium, the small punctures on pronotum and elytra, and by its geographic distribution south of the Amazon River.

DISTRIBUTION. *Strategus surinamensis hirtus* is distributed from the Amazon River south to Argentina, with records in Perú, Bolivia and Paraguay (Ratcliffe 1976).

LOCALITY RECORDS. (Fig. 94) 35 specimens examined (11 males, 24 females). Specimens were seen from the following collections: INPA, MZSP, MPEG.

ACRE (9): Feijó, Rio Branco. AMAZONAS (3): Benjamin Constant, BR 319 km 335, BR 319 Km 350. MATO GROSSO (7): Chapada dos Guimarães (Fazenda Buriti), Barra dos Bugres (Reserva Ecológica

Serra das Araras), Barra do Tapirapé. PARÁ (16): Belém, Itaituba (Rio Tapajós), Santarém, Serra Norte (igarapé Fofoca).

TEMPORAL DISTRIBUTION. January (1), February (1), September (1), October (3), November (14), December (12)

BIOLOGY. Adults are attracted to lights. In Brazil, they have been taken in coconut nurseries (Vayssiere 1965). According to Lourenção et al. (1999), *S. surinamensis hirtus* is a pest of 13 species of Arecaceae in several places in São Paulo state, causing great damage and death to palm trees.

In Peruvian Amazonia, adults attacks the young leaves and stem bases of the palm, *Bactris gasipaes* Kunth, where they form galleries of 30 cm in depth. The larvae grow in rotten trunks feeding on organic matter (Couturier et al. 1996).

In the Brazilian Amazon, adults have been collected from secondary vegetation areas, areas of seasonal whitewater inundation forest (várzea), and ombrophilous forests at elevations ranging from sea level to 200 meters.

Strategus surinamensis surinamensis Burmeister 1847
(Fig. 95-101)

Strategus surinamensis surinamensis Burmeister 1847: 135

DESCRIPTION. Width: 15.4-21.6 mm (males); 15.4-19.2 mm (females). Length: 28.9-40.2 mm (males); 33.3-39.8 mm (females). Color: Castaneous to piceous.

Males. *Head*: Frons moderately rugose, surface with 2 small, conical, widely separated tubercles Eye canthus with surface punctate to rugose, apex rounded. Clypeus with apex narrow, weakly acuminate, moderately reflexed (Fig. 96), surface rugose. Antenna with 10 segments, club subequal in length to segments 2-7. Mandibles with 3 lobes; basal lobe small, apex rounded; middle lobe large, subtriangular, apex rounded; apical lobe small, apex rounded. *Pronotum*: Base with rugopunctate band, band reduced to basal bead at middle. Anterior half with small, deep punctures. Sides rugose, with small punctures. Fovea deep, usually with a longitudinal carina extending posteriorly from base of anterior horn. Majors (Fig. 97) with anterior horn long, slender, curving forward, apex rounded. Posterior horns long, stout, laterally compressed, apex rounded, subparallel in lateral view. Minors with anterior horn short, conical; posterior horns low and rounded, slightly laterally compressed. *Elytra*: Sutural stria strongly impressed, crenulate, deep. Surface granulate to punctate, punctures very small; occasionally with 1-3 feebly impressed striae. Sides with 2-3 short rows of moderately deep, ocellate punctures behind humerus. *Pygidium*: Surface finely granulate, sparsely punctate, punctures small. Posterior margin with a band of long, yellow to reddish brown setae. Angles rugose. In lateral view, strongly convex. *Legs*: Protibia quadridentate. Apex of posterior tibia with 2-3 teeth, median tooth reduced, with rounded apex. First tarsomere of posterior tarsus elongated, quadrangular (Fig. 98). *Venter*: Prosternal process densely setose, long, apex rounded. *Parameres*: Oval, slightly variable in degree of curvature, apex setose on inner region (Fig. 99-100).

Females. As males except in the following respects: *Head*: Frons rugose. Mandibles similar in size, middle lobe smaller. *Pronotum*: Sides with lateral margin punctate to rugose in posterior half. Fovea reduced, moderately deep, surface rugose. Tubercles conical, transverse. *Pygidium*: Surface completely rugose to punctate, densely setose, setae long. Apex with 2 small bands of setae. In lateral view, basal half convex, apical half moderately concave.

DIAGNOSIS. *Strategus surinamensis surinamensis* is distinguished from other *Strategus* species that occur in Brazilian Amazonia, especially *S. surinamensis hirtus,* by the sparsely punctate and finely granulate surface of the pygidium with a band of long setae in posterior region. In males, the posterior horns are more robust and erect.

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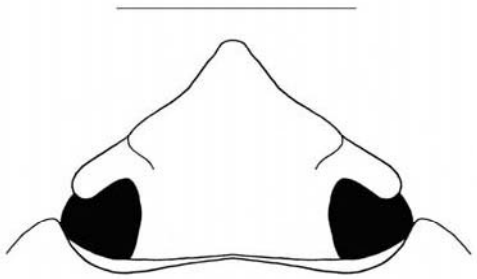

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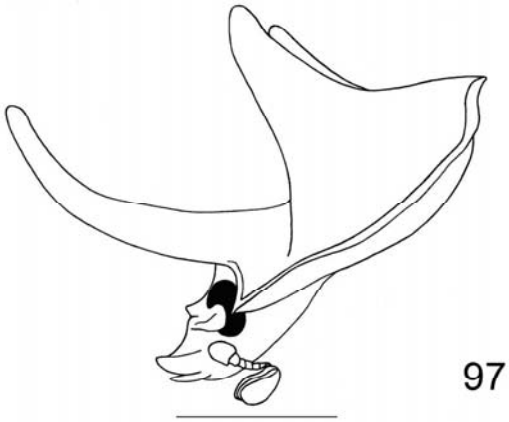

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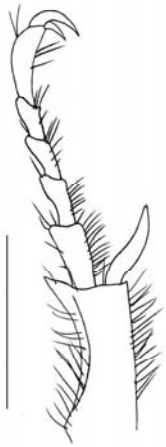

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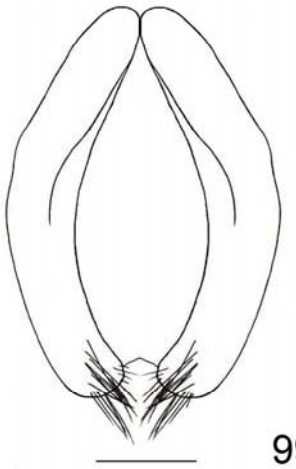

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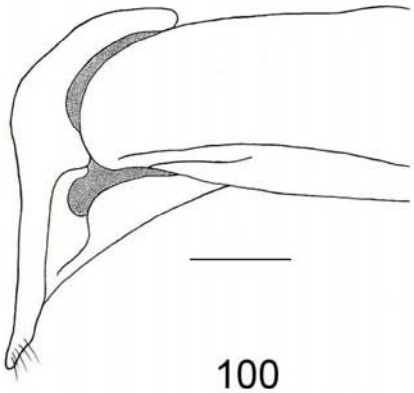

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Figure 95-100. *Strategus surinamensis surinamensis*. **95)** Habitus. **96)** Male head (dorsal view). **97)** Male head and pronotum (lateral view). **98)** Metatarsus (scale line: 5 mm). **99)** Parameres frontal view. **100)** Parameres lateral view (scale line: 1 mm).

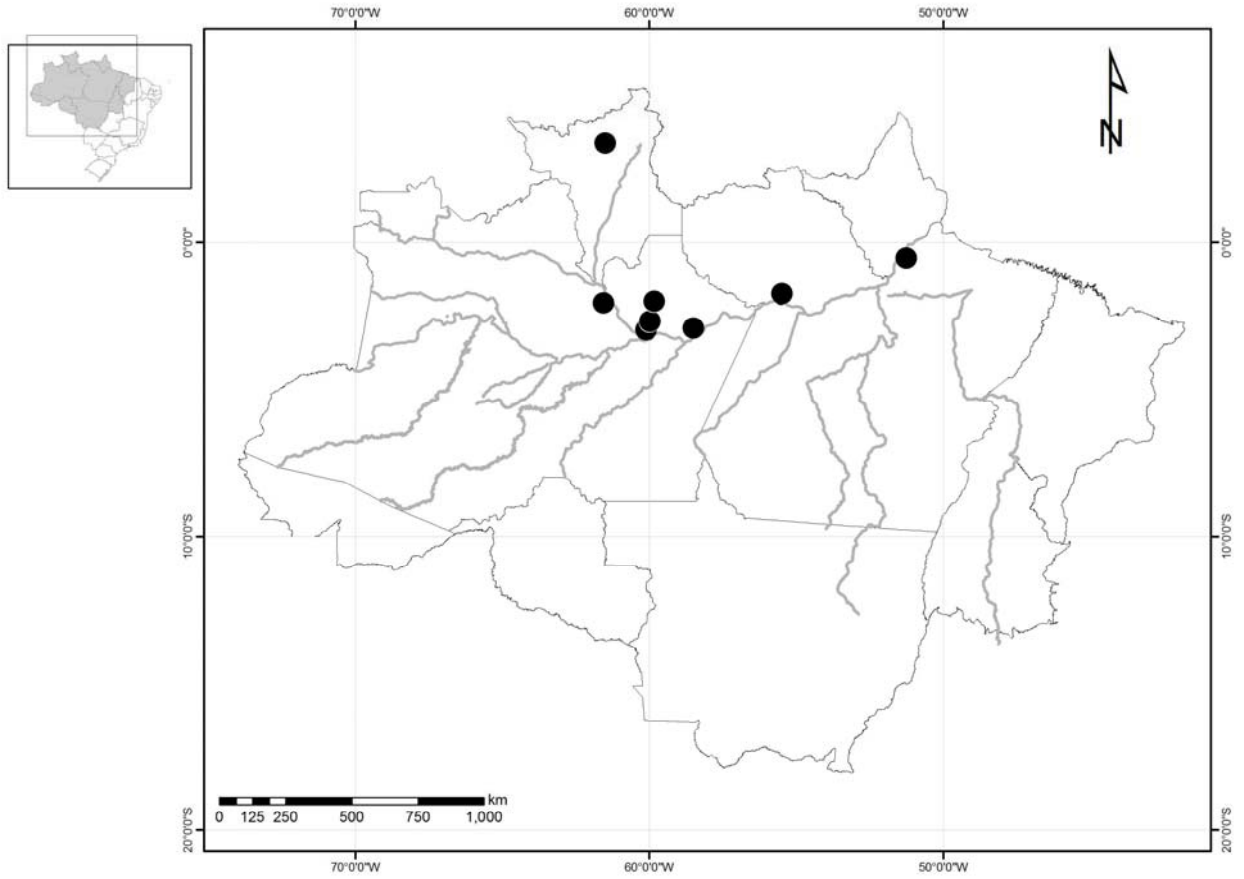

Figure 101. Distribution of *Strategus surinamensis surinamensis* in Brazilian Amazonia.

DISTRIBUTION. *Strategus surinamemsis surinamensis* is distributed from the Amazon River north to Venezuela, with records in Ecuador, French Guiana, Guyana, and Trinidad (Ratcliffe 1976).

LOCALITY RECORDS. (Fig. 101) 36 specimens examined (13 males, 23 females). Specimens were seen from the following collections: INPA, CZPB, MZSP.

AMAZONAS (18): Itacoatiara (Fazenda Aruanã Am 10 km 215, Ponte Mamoud Amed Am 10), Manaus (Fazenda Esteio Am 10 km 60, Reserva Ducke, INPA), Parque Nacional do Jaú (Rio Carabinani). PARÁ (5): Canindé, Óbidos. RORAIMA (10): Amajari (ilha de Maracá, Rio Uraricoera).

TEMPORAL DISTRIBUTION. January (3), February (3), March (3, April (1), May (3), June (4), July (1), August (1), September (1), November (2), December (1).

BIOLOGY. Adults are nocturnal and are attracted to lights. *Strategus surinamensis surinamensis* was reported as a pest of *Bactris gasipaes* in Roraima, feeding at night on young palms and destroying the apical tissues (Trevisan and Fernandes Dias 2004).

In Brazilian Amazonia, adults have been collected from savannah, agricultural areas, ombrophilous forests, and areas of seasonal whitewater inundation forest (várzea) at elevations ranging from sea level to 80 meters.

***Strategus validus* (Fabricius 1775)**
(Fig. 102-106)

Scarabaeus validus Fabricius 1775: 6
Scarabaeus tricornis Jablonski 1785: 269 (synonym)
Scarabaeus validus Fabricius 1787: 4 (redescription)
Oryctes faunus Billberg 1820: 383 (synonym)
Strategus tridens Burmeister 1847:133 (synonym, *nomem nudum*)

DESCRIPTION. Length: 31.1-49.6 (males); 41.7-43.6 (females). Width: 15.1-24.4 mm (males); 21.9-23.5 (females). Color: Reddish brown to black.

Males. *Head*: Frons with surface rugose to punctate, with 2 conical, widely separated tubercles. Eye canthus with surface rugose, apex rounded. Clypeus with apex broadly truncate, occasionally with notch at center, reflexed. Antenna with 10 segments, club subequal in length to segments 2-7. Mandibles with 3 lobes; basal lobe small, apex rounded; middle lobe large, subtriangular, apex rounded; apical lobe small, triangular. *Pronotum*: Base with rugopunctate band, band reduced to basal bead at middle. Sides with small, deep punctures. Majors (Fig. 102) with anterior long, slender, forward curving horn, apex rounded. Posterior horns long, stout, laterally compressed, apex rounded, slightly divergent. Minors with anterior horn short, conical, apex strongly rounded. Posterior horns short, triangular, laterally compressed, subparallel. *Elytra*: Sutural stria strongly impressed, crenulate. Surface punctate, punctures small. Lateral half of disc with incomplete striae. Sides with punctures, usually with 1-5 rows of ocellate, moderately deep punctures behind humerus (Fig. 103). Apex strongly punctate. *Pygidium*: Surface granulate, finely punctate, punctures small. In lateral view, convex. *Legs*: Protibia quadridentate. Apex of posterior tibia with 2 teeth, occasionally with 3, median tooth with apex strongly rounded. First tarsomere of posterior tarsus triangular, apex extended into long spine. *Venter*: Prosternal process long, stout, apex densely setose. *Parameres*: Oval, narrow, apex weakly dilated, setose, usually subparallel (Fig. 104-105).

Females. As males except in the following respects: *Head*: Frons with surface rugose. Clypeus with apex truncate to subtruncate, surface punctate. Mandibles smaller in size, lobes with apex rounded. *Pronotum*: Surface of anterior half rugose. Sides moderately punctate, punctures small to large. Fovea deep, surface rugose. *Elytra*: Surface of sides with incomplete rows of punctures behind humerus. *Pygidium*: Surface strongly granulate. Posterior margin with band of smaller setae. Apex with 2 bands of small setae. In lateral view, basal half convex, apical half concave.

DIAGNOSIS. *Strategus validus* is separated from *S. aloeus* by the rows (1-5) of ocellate, deep punctures behind the humerus, clypeus broadly truncate, and the characteristic shape of the parameres.

DISTRIBUTION. *Strategus validus* is restricted to South America and is widely distributed in Brazil, Argentina, Paraguay, and Uruguay (Ratcliffe 1976).

LOCALITY RECORDS. (Fig. 106) 18 specimens examined (5 males, 13 females). Specimens were seen from the following collections: INPA, CZPB, MZSP, MPEG.

ACRE (1): Tarauacá (Rio Tarauacá). AMAZONAS (9): Benjamin Constant (Rio Javari), Coari (Rio Urucu), Itacoatiara, Novo Airão (Ajaru), Presidente Figueredo (UHE-Balbina), Tefé. PARÁ (6): Belém, Itaituba (Parque Nacional Amazônia), Melgaço Caxiuanã (Estação Científica Ferreira Penna), Santarém. RONDÔNIA (1): Porto Velho (Rio Madeira).

TEMPORAL DISTRIBUTION. February (3), June (1), July (7), August (1), September (2), October (2), December (1).

BIOLOGY. Little is known about the life history of *S. validus*. Adults are nocturnal and are attracted to lights. Larvae has been collected from large, dead tree trunks (Costa et al. 1988). Gonçalves (1946) observed adults attacking the base of young "carnauba" plants, *Copernica cerifera*. Pereira et al. (1977)

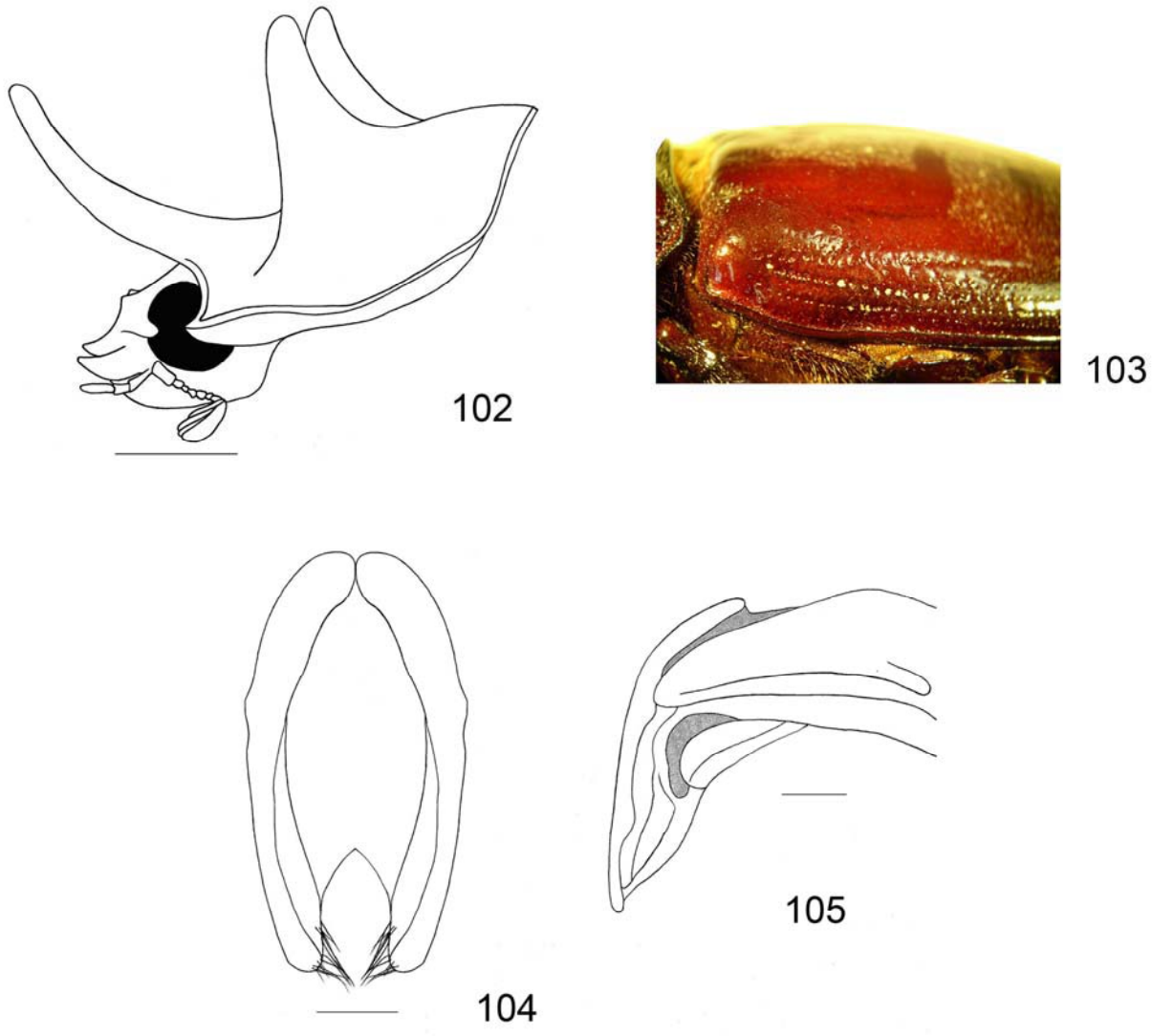

Figure 102-105. *Strategus validus*. **102)** Male head and pronotum (scale line: 5 mm). **103)** Elytra (lateral view). **104)** Parameres frontal view. **105)** Parameres lateral view (scale line: 1 mm).

conducted studies about the penetration depth of *S. validus* in sandy soils. Quinderé et al. (1977) observed that the larvae of *S. validus* attack young coconut palms in the northeastern Brazil, making irregular galleries and penetrating the base of the plant toward the stem.

In Brazilian Amazonia, adults have been collected from ombrophilous forests and areas of seasonal whitewater inundation forest (várzea) at elevations ranging from sea level to 200 meters.

General Remarks

The results of this study were based on the examination of 1532 specimens, that included 7 genera, 18 species, and 2 subspecies. Five of these species are reported for the first time from Brazilian Amazonia. The material examined represented 7 states, 97 provinces, and approximately 167 localities in the study area.

Overall, the tribe Oryctini shows a wide distribution in the Brazilian Amazon. The distribution data suggests the states with the highest oryctine diversity were Amazonas and Pará, with 17 and 13 species respectively; these states also had the greatest number of localities recorded. Amapa and Mato Grosso had

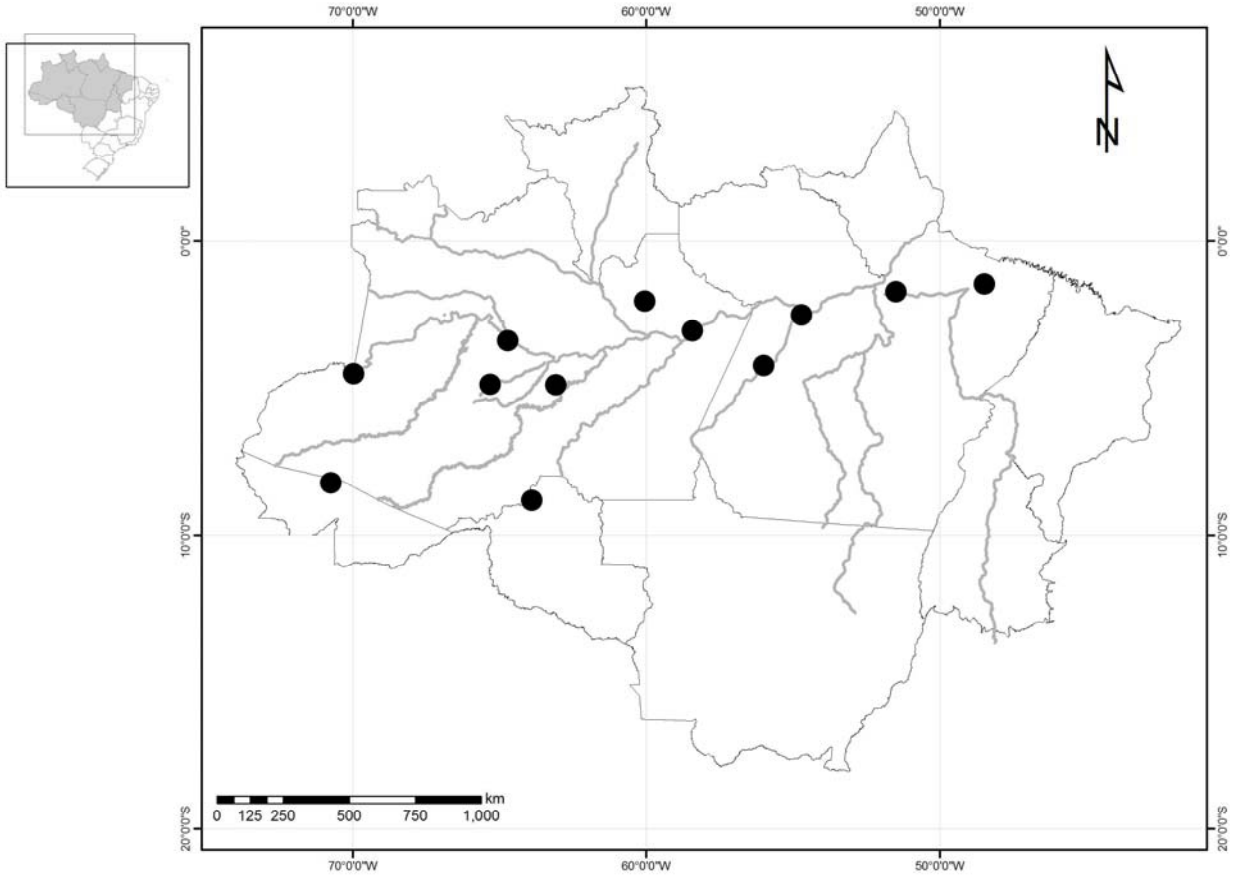

Figure 106. Distribution of *Strategus validus* in Brazilian Amazonia.

fewer species, with 4 species each. The states of Tocantins and Maranhão had no records, but this probably reflects little or no collecting effort (Table 1).

Coelosis biloba, *Strategus aloeus* and *Enema pan* have broad distributions and are considered common species in Brazilian Amazonia. They have all been recorded from seven states in the study area (Table 1). These species have a wide distribution in the Neotropics, some ranging from the southern United States to northern Paraguay. They seem to be ecological generalists inhabiting various types of mountain ecosystems, humid forests, savannah environments, and even agroecosystems (Endrödi 1985; Ratcliffe 2003; Ratcliffe and Cave 2006).

The faunistic survey of Oryctini in Brazilian Amazonia, confirmed the high biodiversity of this large area of tropical forest. Compared with other faunistic surveys conducted in the Neotropics, the Brazilian Amazon contains more species of Oryctini than Costa Rica and Panama together, or that of El Salvador, Honduras and Nicaragua together, and more than half of the species known from Mexico (Table 2).

One hypothesis that explains the diversity and distribution patterns of Amazonian biota is the refuge theory, where several dry climatic periods of the Pleistocene and post-Pleistocene reduced the Amazon forest to smaller, disjunct forests, which served as refugia for populations of animals which then differentiated from one another during these periods of geographic isolation. The isolated areas later expanded again during periods of humid climatic conditions, thus permitting the refuge area populations to extend their ranges. This process of separation and connection of forests was repeated several times, which favored high speciation in successive periods of ecological isolation (Haffer 1969; Vuilleumier 1971). Conversely, Amorim (2001), suggested the refuge theory does not offer a general method for biogeographic reconstruction, and the succession of climatic cycles as the chief cause of speciation cannot explain the patterns of distribution in the region.

Table 1. Species of Oryctini occurring in each state of Brazilian Amazonia. AC: Acre, AP: Amapá, AM: Amazonas, PA: Pará, RO: Rondônia, RR: Roraima, MT: Mato Grosso.

Species	AC	AP	AM	PA	RO	RR	MT
Coelosis biloba (Linnaeus, 1767)	●	●	●	●	●	●	●
Coelosis bicornis (Leske, 1779)				●	●	●	●
Enema pan (Fabricius, 1775)	●		●	●	●		●
Enema endymion Chevrolat, 1843				●			
Gibboryctes waldenfelsi (Endrödi, 1977)			●				
Heterogomphus eteocles Burmeister, 1847			●	●			
Heterogomphus aidoneus (Perty, 1830)				●			
Heterogomphus ulysses Burmeister, 1847			●		●		●
Heterogomphus telamon (Burmeister, 1847)			●				
Megaceras philoctetes (Olivier, 1789)		●	●	●	●		
Megaceras crassum Prell, 1914			●				
Megaceras laevipenne Prell, 1914		●	●				
Megaceras stuebeli Kirsch, 1885			●	●	●		
Podischnus agenor (Olivier, 1789)	●		●	●			
Podischnus sexdentatus (Taschenberg, 1870)	●		●				
Strategus aloeus (Linnaeus, 1758)	●	●	●	●	●	●	
Strategus surinamensis surinamensis Burmeister, 1847			●	●		●	
Strategus surinamensis hirtus Sternberg, 1910	●		●	●			●
Strategus validus (Fabricius, 1775)	●		●	●	●		
TOTAL	7	4	17	13	8	4	4

Another fact that influenced speciation in Amazonia was the interglacial periods of sea transgression in the Amazon basin in the Pleistocene. This resulting complex network of rivers served as an active barrier that prevented the dispersal of organisms (Wallace 1852). This may have been responsible for subspeciation of *Strategus surinamensis* into *S. surinamensis hirtus* distributed south of the Amazon River and *S. surinamensis surinamensis* north of the Amazon River (Ratcliffe 1976). A similar situation may be happening with *Heterogomphus telamom*, whose geographical distribution is in northern Amazonia (Fig. 38) and *Heterogomphus ulysses* with records south of the Amazon River (Fig. 45).

The Amazon is considered a biogeographical heterogeneous area, where animal and plant communities are different and form a mosaic of separate areas of endemism delimited by major rivers, each with its own evolutionary history (da Silva et al. 2005). These smaller areas of endemism are the biogeographical units best suited for analysis of historical biogeography, and they are important for the formulation of hypotheses about the processes responsible for the formation of regional biotas (Morrone 1994; Morrone

Table 2. Diversity of Oryctini in several regions of the Neotropics.

	Costa Rica Panama [1]	Honduras El Salvador Nicaragua [2]	Mexico [3]	Brazilian Amazon [4]
Genera	9	8	7	7
Species (Subspecies)	17	17	27	18 (2)

[1]: Ratcliffe (2003), [2]: Ratcliffe and Cave (2006), [3]: Morón et al. (1997), [4]: Current study.

and Crisci 1995). Currently it is generally accepted that the biotic diversity of Amazonia is related directly to historical factors that influenced the emergence of areas of endemism (Amorim 2001).

The geologic history of the Amazon region is another factor that may explain the diversity and distributional patterns of plant and animal species. Botanical and geological studies showed that the complex geological history of the Amazon created areas with different edaphic conditions that support communities of different species (Räsänen et al. 1992, 1995). The conditions of soil, determined by climate and geological processes, are clearly related to the patterns of distribution of various groups of plants such as Passifloraceae (Gentry 1981), trees (Tuomisto et al. 1995), Pteridophyta (Tuomisto and Poulsen 1996, 1998), and Melastomataceae (Ruokolainen et al. 1997). Some of these soil areas coincide or are within the areas of endemism for some terrestrial vertebrates (da Silva et al. 2005), birds (Haffer and Prance 2001), amphibians (Ron 2000), primates (Silva and Oren 1996), and forest butterflies (Hall and Harvey 2002), thus indicating some degree of congruence for patterns of distribution of different taxonomic groups.

Although the Amazon is considered a biodiverse region, some genera of neotropical Oryctini are more diversified in southern South America The genus *Coelosis*, with seven species, has two species recorded in the Brazilian Amazon, as well as Colombia and Venezuela, while the other five species are distributed from southern Mato Grosso to Argentina. A similar situation occurs with *Heterogomphus* species with four of the 42 species occurring in the Neotropics being recorded from the Brazilian Amazon, while the other 38 species are distributed in Central America, the Andean countries of South America, and from southern Brazil to Argentina. The relative lack of dynastine species in the Amazon region may be an indicator of a re-colonization pattern from both the north and the south of the Amazon River as the inland Amazonian sea retreated. See, for example, *Strategus* species (Ratcliffe 1976), where only four species of 31 are distributed in Amazonia.

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